THE

Pictorial Museum

OF

ANIMATED NATURE.

VOLUME II.

BIRDS. REPTILES. MOLLUSCA. INSECTS.

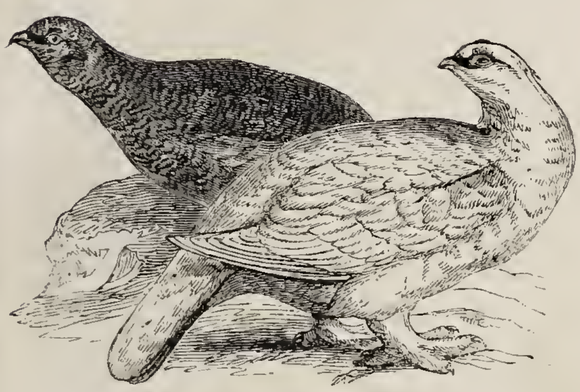
LONDON:
CHARLES KNIGHT AND CO., LUDGATE STREET.

PRICE EIGHTEEN SHILLINGS, BOUND IN CLOTH.

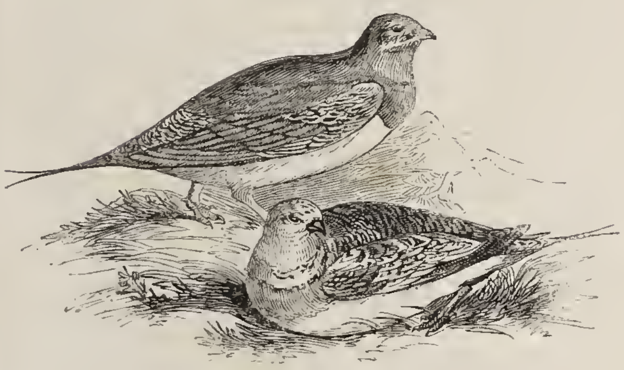
1770.—Partridge.

1772.—Virginian Quail.

1771.—Rock Quail.



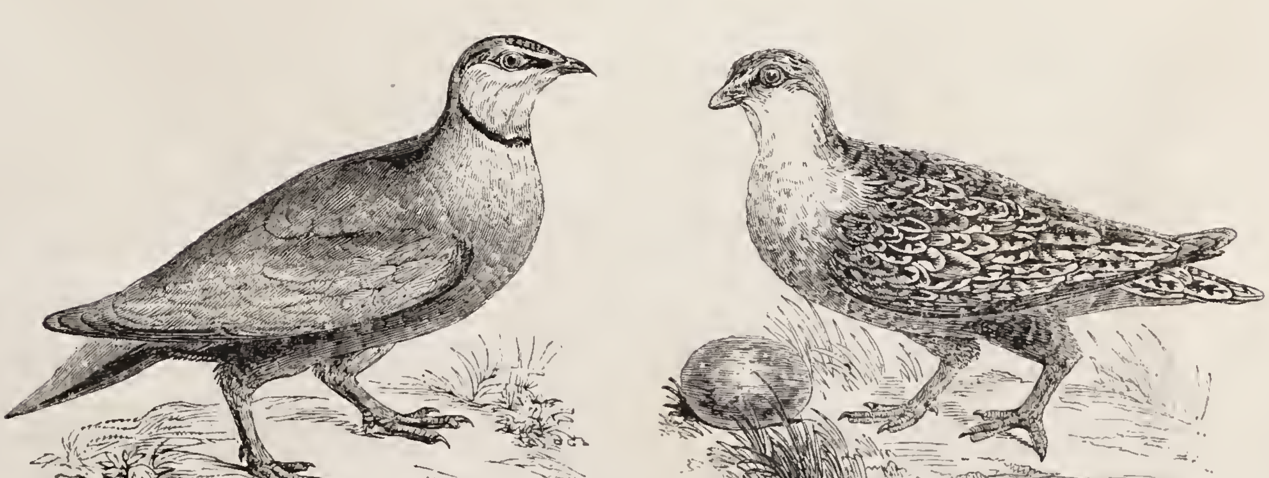
1765.—Ptarmigans.



1767.—Pin-tailed Sand Grouse.

1766.—Ptarmigans.

1768.—Pin-tailed Sand-Grouse.



1769.—Throat-banded Sand-Grouse. Male and Female.

1765, 1766.—The Ptarmigan

(*Lagopus mutus*). Gelinote blanche, l'Attages blanc. of the French; Pernice alpestre and Lagopo bianco of the Italians; Schneehuhn and Hassenfüssige Waldhuhn of the Germans; Rype of the Norwegians; Riupkarre (male) and Riupa (female) of the Icelanders; Tarmachan of the Highland Gael; Coriar yr Alban of the Welsh. In this genus the legs and toes are completely clothed with hair-like feathers to the very claws, and in winter so thick and deep does this covering become, as to give to the leg the appearance of a "hare's foot." Small closely-set feathers also invest the base of the beak, which increase, during the colder season, till little more than the point of the latter is visible. A naked skin rises above each eye.

The Ptarmigan is a native of the dreary mountain regions of the north of Europe, the Alpine districts of central Europe, and the northern parts of America, including the islands lying to the south-west of Baffin's Bay. It is found in the British Islands, being common on the Grampians, where great granite and slaty masses afford it concealment. It is found also in tolerable abundance on the elevated summits of the mountains in the north of Scotland, and the adjacent islands. Mountain berries and heath-shoots in summer, buds and leaves in winter, constitute the food of the ptarmigan; and at this season the birds are often obliged to burrow under the snow, partly perhaps for shelter, but principally in quest of food. After the breeding-season the various young coveys and their parents associate in large flocks, consisting of forty or fifty individuals, which separate into pairs early in the spring. The nest, if it deserve the name, consists of a few twigs and stalks of grass, loosely arranged in a slight depression on the ground; the eggs, fourteen or fifteen in number, are of a pale reddish white, spotted with dark brown. The young run about as soon as they leave the shell, and are quite on the alert, concealing themselves with great skill on the appearance of danger. The alarm-call of the ptarmigan is a strange croaking cry, and so well do the mingled colours of these birds blend with the fragments of out-cropping rock, weather-stained and covered by many-tinted lichens and mosses, that a person may pass very near a covey without perceiving them, unless one utters his call, or they rise suddenly upon the wing.

One of the most remarkable facts connected with the history of this species is its change from a rich and spotted livery, its summer dress, to one of pure white. In spring, for example, the plumage is varied with black and deep reddish yellow, the quill-feathers being white with black shafts. Towards autumn the yellow gives place to greyish white, and the black spots become irregularly broken, till at last they disappear, the plumage whitening to the purity of snow. At the same time it acquires greater fulness; and the legs and feet are so densely clad as to resemble those of a hare. As spring returns, the ptarmigan begins to lose the pure white of his plumage, and regain his summer dress.

Of the number of ptarmigans imported during the latter part of the winter and early in the spring from Norway, Sweden, &c., to the London market, few persons have any idea. "On one occasion," says Mr. Yarrell, "late in the spring of 1839, one party shipped six thousand ptarmigans for London, two thousand for Hull, and two thousand for Liverpool; and at the end of February or very early in March of the year 1840, one salesman in Leadenhall Market received fifteen thousand ptarmigan that had been consigned to him, and during the same week another salesman received seven hundred capercaillies, and five hundred and sixty black grouse." From Drannen in Norway, in 1839, two thousand dozen of ptarmigans were exported in one ship for London. Sixty thousand have been killed in a single parish during the course of the winter. The total of these birds destroyed throughout Norway and Sweden every season, we do not know, but it must be enormous.

With respect to the red grouse (Lagopus Scoticus), it is exclusively peculiar to the British Islands, being found in no part of the Continent. This beautiful and valued bird is common on the high moorland districts of the northern counties of England, Scotland, Wales, and Ireland, where the heath affords it shelter and concealment. During the autumn and winter it associates in flocks or packs, which are often wild and shy, and not easily approached. Early in the spring the sexes pair; the female lays her eggs in March, making a rude nest of sprigs of heath and grass upon the ground, under the shelter of a tuft of heath or of the bilberry plant (Vaccinium Myrtillus). The young are strong on the wing by August. The male takes no part in the labour of incubation, but joins the female and the young brood as soon as hatched, and is as attentive to the latter as the female parent. The red grouse feeds upon the tender shoots of heath, on bilberries, whortleberries, and the berries of other species of Vaccinium, and also upon oats, for which it will visit the stubble lands bordering the moors. Its flight is rapid and powerful.

The plumage of the red grouse is very rich, the general tint being deep chestnut, diversified with zigzag bars and dots of black; the legs and toes are thickly clad with hair-like feathers, and a bright scarlet fringed skin, largest in the male, surmounts the eye.

1767, 1768.—The Pin-tailed Sand-Grouse

(*Pterocles setarius*). The sand-grouse are natives of the sandy plains and rocky deserts of Africa, Asia, and the southern districts of Europe. They are distinguished by long pointed wings, and a conical form of tail, the two middle tail-feathers being in some species much elongated. Birds of powerful and rapid flight, they love to wander from place to place, sweeping over the hot and arid solitudes in which they find a congenial abode. Some are gregarious, associating in vast flocks, others live in pairs; the prevailing tints of their plumage are grey, sandy yellow, chestnut, olive, and black.

The pin-tailed sand-grouse is found in the south of Spain, the north of Africa, and the deserts of Arabia and Syria. The stony districts of the country beyond Jordan swarm with these birds, there called Katta. Near Boszra, says Burckhardt, "the quantity of Kattas is beyond description; the whole plain seemed sometimes to rise; and far off in the air they were seen like large moving clouds." In the mountains of Edom their numbers are equally great, and so dense are the flocks that the Arab boys often kill two or three at a time by merely throwing a stick among them. According to Russell they are common at all seasons, but most abound in May and June, when, even in northern Syria, a quantity sufficient to load an ass may sometimes be taken at one shutting of the clasp-net. Their flesh is dry, black, and hard, but is nevertheless relished by the Turks, though it is never seen at the tables of the Franks. This bird lays two or three eggs, of a greenish black colour, and about the size of those of a pigeon. They are placed on the dry ground without any nest. The Arabs collect them in large quantities, and eat them fried in butter. Burckhardt suggests that this bird is the quail (Selav) of the ancient Israelites, and Hasselquist was of the same opinion. The pin-tailed grouse is distinguished by a broad band of deep chestnut, edged with a line of black, across the chest; the upper surface is elegantly varied by alternate bars of yellow, black, and silvery grey; the two central tail-feathers are elongated into slender points. Size, that of a partridge.

1769.—The Throat-banded Sand-Grouse

(*Pterocles gutturalis*, Smith). Male and Female. This species was discovered by Dr. A. Smith, in South Africa, about eighty miles to the eastward of Latakoo. In common with the other South African species of this genus, it repairs in large flocks, at regular periods, to localities where water is, and when approaching or retiring from such spots, which it does with singular rapidity and suddenness, it utters cries resembling the syllables *twet-weet, twet-weet*. Though these birds crowd in flocks to the water, they are not truly gregarious, but disperse themselves in pairs over the feeding-grounds, whence they take flight at ten in the morning and three in the afternoon to the water; the margins of the pools which they frequent being at those times crowded by hundreds struggling to obtain their refreshment. Dr. Smith found grass seeds, ants, and gravel in the stomachs of most of the individuals he procured. The female deposits her eggs, two or three in number, on the bare ground; they are of a dirty white or cream colour, with irregular streaks and blotches of pale rust colour and grey. Almost as soon as the young escape from the shell they take to a wandering life, and remove from place to place with the parent birds in search of food.

The present species is about twelve inches in length; the male has a dark brown crescent mark across the throat, which is wanting in the female. For minute details see Dr. Smith's 'Illustrations of the Zoology of South Africa.' He enumerates four other species as peculiar to South Africa, and many more natives of Northern Africa, Senegal, &c.

1770.—The Common Partridge

(*Perdix cinerea*). Perdris, Perdris grise, ou des Champs, of the French; Perdice, Pernisette, Pernigona, and Starna of the Italians; Rebhun of the Germans; Coriar of the ancient British; Pertrisen of the modern Welsh.

The Common Partridge is too well known to require minute description: it appears to be confined within the boundaries of Europe, everywhere frequenting cultivated districts and rich corn-lands; hence its increase is encouraged by the conversion of heath, moorland, and wood into fields of waving grain. The pairing time of these birds is about the beginning of February, at which season the males engage in desperate conflicts, and as they are more numerous than the females, the successful combatant in one battle has often to renew the strife with other rivals. The female produces her eggs about the latter part of May or beginning of June, depositing them in a rough nest or shallow depression of the ground, in a corn-field or clover-field, under a tuft of grass in a meadow, or amongst whin bushes. They vary from twelve to twenty in number, and are of a greenish ash colour. So close does the female sit, and so unmoved is she by apprehension of danger, that she frequently falls a victim to the mower's scythe while brooding over her nest. The young, after three weeks' incubation, are hatched in June, or from the beginning to the middle of July; and the male immediately joins his mate in the care of the young brood. From the earliest times the partridge has been celebrated for the various artifices employed to draw off the attention of men and dogs from the young, which at the warning call of their parents have dispersed, and lie cowering in the grass or amidst the standing corn; nor is this all,—they will fight resolutely in defence of their brood, and have been known to engage in combat with the kite and the crow, and accomplish their object. The feeding time of the partridge occupies two or three hours after sunrise, and again in the evening before sunset. The interval they employ in basking and dusting their plumage in sunny places, in preening their feathers, and in taking short flights from one spot to another. They roost at night upon the ground, near the centre of a field, in a bare spot, and at a sunset may be heard calling to each other, till the covey, which sits crowded together, is complete.

The Red-legged Partridge (Perdix rubra), a species abundant in France and Italy, and a native also of the islands of Guernsey and Jersey, has within the last few years been introduced into some of the preserves of game in our island, and in various parts has considerably multiplied; but to the injury of the common partridge, which it fiercely persecutes, usurping its legitimate territory. Its flesh is very inferior to that of the latter, and the sportsman to his annoyance finds that the birds, instead of rising, run, soon spoiling the behaviour of his best-trained pointers. The red-legged partridge is very beautiful, having the feathers of the sides ornamented with a series of crescent-shaped bars of black, white, and chestnut; the throat is white, bordered by a deep black band; the general colour of the upper surface is reddish brown, of the under surface reddish yellow. Closely allied to this species are the Greek partridge (Perdix saxatilis), the Barbary partridge (P. petrosa), and the Chukar partridge from India (P. Chukar). All have a rudimentary blunt spur on the legs.

To our common partridge, not only in plumage and form, but in the spurless condition of the legs, the Quails (Coturnix) bear a close resemblance. The European Quail (Coturnix dactylisonans; the ὄρτυξ of Aristotle; Coturnix of the Latins; Quaglia of the modern Italians; Caille of the French; and Wachtel of the Germans) is known over the greater part of the old world, and is a summer visitant, though not in great numbers, to our island. In Italy, Spain, and Portugal, the quail may be regarded as stationary, flocks or bevies remaining during the winter, but increased every spring by an accession of visitors from the parched plains of Africa, the winter asylum of myriads which make Europe and the adjacent parts of Asia their annual summer residence. In India we believe the quail is not migratory. During their periodical flights between Europe and Africa, and *vice versâ*, the shores and islands of the Mediterranean are replete with myriads. Sicily swarms with them—their autumnal arrival is looked forward to with great anxiety, and they are shot and captured by wholesale. On the coasts of the kingdom of Naples a hundred thousand have been destroyed in one day. According to Baron de Tott, no country abounds in quails more than the Crimea. During the summer these birds are dispersed over the country, "but assemble at the approach of autumn, and cross the Black Sea to the southern coasts, whence they afterwards transport themselves into a warmer climate. The order of this emigration is invariable: toward the end of August, in a serene day, when the wind blows from the north at sunset, and promises a fine night, they

repair to the strand, take their departure at six or seven in the evening, and have finished a journey of fifty leagues by break of day." Nets are spread on the opposite shore, and persons are assembled to capture the birds exhausted by their flight. The migrations of the quail have in fact been noticed by the ancients, from Aristotle to Pliny; and the latter asserts that, blown by adverse winds out of their course, whole flocks are often swept into the sea, and that sometimes they settle on vessels in such numbers as to cause their sinking. "Advolant . . . . non sine periculo navigantium cum appropinquavere terris, quippe velis sæpe insident, et semper noctu, merguntque navigia." (Plin. 'Hist. Nat.' lib. x.) Hasselquist states that in Egypt amazing flocks of these birds arrive in the month of March, when the wheat ripens there, and are caught in thousands by means of nets.

The flesh of the quail is very delicate. Our London markets are supplied principally from France, and thousands are there captured by means of a quail-pipe which imitates their call; but, as Mr. Selby observes, "by this device males only are taken, which may account for the few female specimens found amongst the many hundreds kept in confinement by the London poulterers." We may add that the males precede the arrival of the females by a few days.

According to Pliny, the Romans entertained a prejudice against the flesh of these birds, in consequence of their feeding on the grains of the hellebore, and their being subject to epilepsy. Other nations, however, do not seem to have partaken of this prejudice. The quail is polygamous; the nest consists merely of a few dried stalks in some convenient receptacle on the ground, generally in a field of wheat; the eggs are from twelve to eighteen in number, of a light greenish hue, blotched with brown. The pugnacious habits of the quail are well known: "As quarrelsome as quails in a cage," was an ancient saying. The males fight with the spirit and resolution of game-cocks; hence the Greeks and Romans kept them for the purpose of fighting, and the same practice prevails in China and India at the present day.

The colours of the quail are very pleasing, being a mixture of black, chestnut, yellow, and white; the markings vary in intensity, but the males are always characterized by a black border round the throat, which is wanting in the female. Length seven inches and a half.

1771.—THE ROCK-QUAIL

(*Coturnix Argoondah*). This species, described by Colonel Sykes, is a native of the Dukhun. It feeds principally upon grass seeds, which were exclusively found in the stomachs of the birds Colonel Sykes obtained. He states that they do not frequent cultivated lands, but are found all over the Dukhun on the general level of the country, amidst rocks and low bushes, and that they rise in coveys of from ten to twenty or more, from under the feet, with startling suddenness and bustle, so that the young sportsman is perplexed in selecting his bird. They are gregarious, and probably polygamous; Colonel Sykes never saw them solitary or in pairs. The flesh is white. This species is used by the natives for quail-fights. General colour above rufous brown with narrow ferruginous bars; under parts dirty white with black bars; forehead ferruginous; a stripe over the eye reddish white. Length six inches and a half.

1772.—THE VIRGINIAN QUAIL

(*Ortyx Virginiana*). The genus Ortyx, characterized by a peculiarly short, high, thick bill, is the American representative of the genus Coturnix of the Old World.

According to Wilson, the Virginian or Maryland quail is a general inhabitant of North America, from the northern parts of Canada, to the extremity of Florida; and is numerous in Kentucky and Ohio. It frequents the vicinity of cultivated lands where grain is in plenty; and though the coveys sometimes take shelter in woods or among brushes, they are most usually found in the open fields or along fences of briars. Where not much persecuted by sportsmen, they become almost half domesticated, and in winter approach the farm-yard, mixing with the poultry, and there gleaning their subsistence. It would appear, indeed, that with little trouble this species might be domesticated. The Virginian quail begins to build early in May, making a thick nest of leaves and dried grass, under a tuft of grass that shelters and conceals it; it is domed, and has a lateral entrance. The eggs are from ten to eighteen, and of a pure white; the male at times assists in hatching them. The young run about as soon as liberated, and follow their parents until spring. These birds roost at night in the middle of a field on the grass, the covey forming a circle, with their heads outwards; an arrangement which enables them both to prevent surprise, and to take wing and scatter asunder when alarmed.

The usual cry of this bird is a clear whistle, but the call of the male in the pairing season consists of three distinct notes, sounding like the words "Ah, Bob White," the first note a kind of aspiration, the two last loud and clear. In the middle of April the male may be seen perched on a fence-stake or some low branch, uttering his call for hours: should he hear the note of a female, he sails directly towards the spot whence it proceeded; but it often happens that the call of a rival at a little distance sounds a challenge — hence obstinate combats often take place.

The gun, the net, various traps and devices thin the numbers of the Virginian quail or partridge, its flesh being held in high estimation; it is also kept in coops or cages, and soon becomes very fat. Its ordinary food consists of grain and berries, but it feeds on ants and various insects. According to Audubon, flocks of this species in October perform occasional migrations from the north-west to the south-east, somewhat in the manner of the wild turkey.

This species has the bill black; line over the eye, down the neck, and whole chin pure white, bounded by a descending band of black, which spreads broadly over the throat; eye dark hazel; crown, neck, and upper part of the breast red brown; sides of the neck spotted with white and black on a reddish brown ground; back, scapulars, and lesser coverts red brown, intermixed with ash and sprinkled with black; tertials edged with yellowish white; wings plain dusky; lower part of the breast and belly pale yellowish white, beautifully marked with numerous curving spots or arrow-heads of black; tail ash, sprinkled with reddish brown; legs very pale ash. Length nine inches; extent fourteen (male). The female differs in having the chin and sides of the head yellowish brown. (Wilson.)

1773.—THE CALIFORNIAN PARTRIDGE

(*Ortyx Californica*). Lophortyx Californica, Bonaparte.

This beautiful species is common in the low woods and plains of California, where it was discovered by the unfortunate La Pérouse, and, according to the editor of his voyage, was found in flocks of two or three hundred; the birds were fat and well flavoured. Several living specimens were procured by Captain Beechey, with a view of being brought to England, where it was hoped the species might be naturalized, but unfortunately the plan was defeated by the death of the females on the passage. The males were presented to the Zoological Society, and one of them lived for a considerable time (1833). For some observations on the genus Ortyx by Mr. Vigors, and descriptions of several species, see 'Zool. Proceeds.' 1830, p. 3.

Specimens of the Californian partridge or quail had, however, been previously brought to England by Mr. A. Menzies, who accompanied Vancouver in his expedition round the world, and were described by Shaw and Latham.

In manners these birds closely resemble the partridge or quail, but hold themselves more erect; the graceful crest on the head adding much to their appearance. The general plumage is of a dusky slate colour; the crest, which is bent forwards, is black, as is also the throat, encircled by a belt of white. The feathers at the back of the neck are small and triangular, of a slaty hue, with a narrow black margin and white tip. The feathers of the sides and under surface are of a dull reddish white margined with crescents of black. The female has but little crest, and the general tone of colouring is browner and more obscure. The figure is stout; length about nine inches.

1774.—THE TAIGOOR QUAIL

(*Hemipodius Taigoor*, Sykes). The genus Hemipodius (Turnix, Bon.; Tridactylus, Lacép.; Ortygis, Ill.) has the bill moderate, slender, straight, much compressed, and curved at the point; the tarsi are moderate; the hind-toe is wanting. The tail short and composed of weak feathers; wings moderate. Geographical distribution, Europe, Asia, Africa, Australia. The Taigoor quail was met with by Colonel Sykes in the Dukhun, and closely resembles the female of the H. pugnax, but is a truly distinct species: of its habits nothing definitely is stated, most probably they resemble those of the H. pugnax, or Bustard-quail, respecting which Colonel Sykes says that it lives solitary or in pairs, and is mostly found in Chillee-fields (Capsicum annuum). The colouring of the Taigoor quail is as follows:—plumage above chestnut, the feathers margined with straw yellow, and barred with black; quills brown; throat white; breast barred black and white; under parts pale ferruginous. Length nearly seven inches.

1775.—THE KURRICHANE QUAIL

(*Hemipodius Lepurana*, Smith). This species is a native of South Africa, where it was discovered by Dr. A. Smith, who states that few specimens only were obtained, and these not until the expedition had reached the country north of Latakoo. "The grassy valleys south-east of Kurrichane were the only localities in which they were discovered, and even there they appeared to be but thinly scattered, for more than a single individual was seldom found in or even near the same place. When the birds were disturbed, they seldom flew far before they alighted, upon which they continued their retreat, since none of those flushed a second time were ever found near the spots where they had been marked down." The food consists of seeds and small insects, with which a considerable quantity of fine gravel is swallowed. The general colour is mingled rufous and chestnut, variegated, spotted and barred with dark brown, black, and white. For long detailed descriptions see Dr. A. Smith's 'Zool. of South Africa.'

1776.—THE FERRUGINOUS AND GREY FRANCOLIN

(*Francolinus Ponticerianus*). In the genus Francolinus the bill is stout, of moderate size, convex above; the feet are naked and four-toed, and the tarsi of the male are armed with strong blunt spurs.

The species are spread through Europe, Asia, and Africa. They inhabit the forests, perch on trees, feed on berries, seeds, the tender tops of herbs, and also on bulbous roots. One species (Francolinus vulgaris) inhabits the southern parts of Europe, the north of Africa, and a great portion of the Asiatic continent, as Persia, Bengal, and the Himalaya Mountains.

The Francolinus Ponticerianus is a native of India, and called Teetur by the Marhattas. In the Dukhun, according to Colonel Sykes, it is one of the most common birds, and is called partridge: it frequents gardens and cultivated lands. In the Ghauts it is not met with, unless in well cultivated valleys, and not at all on the mountains. It roosts on trees; and Colonel Sykes has on more than one occasion shot these birds on trees during the daytime—but this is a rare occurrence. Length fourteen inches. ('Proceeds Zool Soc.' 1832, p. 154.)

1777.—THE PILEATED FRANCOLIN

(*Francolinus pileatus*). This fine bird, which measures thirteen inches and a half in length, was discovered by Dr. A. Smith during his late expedition into the interior of South Africa, and was first seen on the banks of the Marikwa river, which flows in a south-easterly direction from Kurrichane. "It showed," says Dr. Smith, "but little disposition to resort to the jungle, though when disturbed in more open localities, which it by choice frequents while feeding, it, like Francolinus Natalensis, seeks concealment in the bosom of the thickets. Early in the morning specimens were observed in moderate abundance upon the open grassy plots which occurred intersecting the wooded regions that skirted both sides of the stream, and there they appeared to find their food in plenty, which was found to consist of small bulbous roots, seeds, insects, &c. To the same localities these birds were also observed to resort towards evening; but at that period they were less readily discovered, owing to their being commonly more silent at that time. During the middle of the day they were rarely observed, and from what was ascertained there were grounds for believing they repose while the sun is warm, and that while enjoying rest they are generally perched upon dwarf trees or shrubs, no doubt to be the more secure from the teeth of the numerous predatory quadrupeds which are constantly traversing the woods in quest of prey." (See 'Illust. of Zool. of South Africa.')

Fig. 1778 represents three species of Francolin, from North Africa, Abyssinia, &c., and the Barbary Partridge: *a*, Clapperton's Francolin (Francolinus Clappertoni); *b*, Rüppell's Francolin (F. Rupellii); *c*, Erckel's Francolin (F. Erckleii); *d*, the Barbary Partridge (Perdix petrosa).

1779.—THE ROULOUL PARTRIDGE

(*Cryptonyx cristatus*). In the genus Cryptonyx the bill is stout, compressed, and convex above; orbits and lore naked; hind toe without a claw, and not touching the ground; wings short; tarsi spurless. Geographical distribution, India and its islands. The Rouloul partridge, called by the Malays Bestum, is a native of Malaya, Sumatra, and Java, where it haunts the vast forests, avoiding the precincts of man's abode; it is wild, shy, and difficult to capture, and is kept alive in confinement with great difficulty. It is the Rouloul de Malacca of Sonnerat.

This is a beautiful species: the male is crested; anterior to the crest rise a few long hair-like feathers: the crest is full and falls back over the occiput; at its origin it is pure white, and then becomes of a fire red. The forehead and upper parts of the neck are blackish blue, contrasting with the red naked skin of the lore and orbits. The upper part of the body is emerald green, the lower part rich azure blue: the wings are ruddy brown; the bill lead-colour; the legs flesh-colour. The tail-

1775.—Kurrichane Quail.

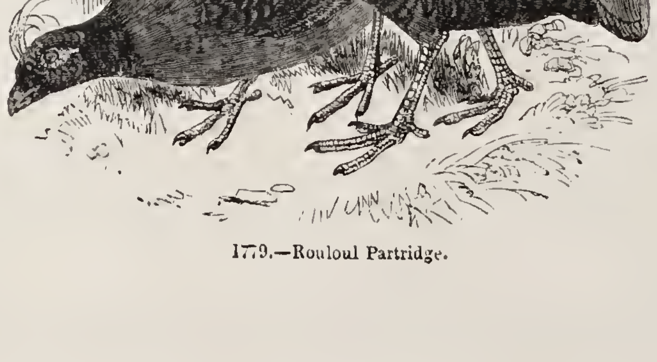
1776.—Ferruginous and Grey Francolin.

1774.—Taigoor Quail.

1778.—Group of Francolins.

1777.—Pileated Francolin.

1780.—Tataupa.



1779.—Rouloul Partridge.

1773.—Californian Partridge.

1782.—Galeated Curassow.

1785.—Hoatzin.

1784.—Motmot Guan.

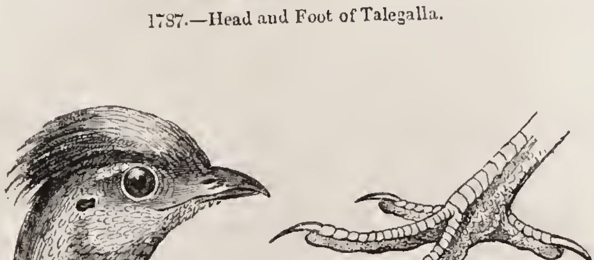
1783.—Crested Guan.

1781.—Crested Curassow.

1787.—Head and Foot of Talegalla.

1788.—Ocellated Leipoa.

1786.—Wattled Talegalla.



1789.—Head and Foot of Leipoa.

feathers, which are short and hidden, are black. Length ten inches. The female wants the crest, but possesses the hair-like appendages of the forehead. The head and neck are deep brown; the whole body uniform grass green; the wings of a ruddy brown waved with dark brown. Of the peculiar habits of this species little is correctly known.

1780.—THE TATAUPA

(*Tinamus Tataupa*, Sw.). The Tinamous, or Ynambus, as Azara calls them, are peculiar to tropical America. They are distinguished by a stout form of body, a depressed bill, broader than high, with the nostrils lateral, medial, and open. The hind-toe is a mere rudiment; the tail is extremely short, and concealed by the rump-feathers; the wings are short. Mr. Swainson observes that the appearance of these birds reminds us of the bustards, which they probably represent in the New World. Their flesh he describes, from personal experience, as infinitely superior, both in flavour and whiteness, to that of the partridge or pheasant. "We believe," he adds, "that these birds never perch, as some suppose, but that they live entirely among herbage in the more open tracts of the interior." Mr. Darwin, who met with a species of this genus near Maldonado, in a district covered with green turf, but wearisome from its sameness, says, "We everywhere saw great numbers of partridges (Tinamous), Tinamus rufescens. These birds do not go in coveys, nor do they conceal themselves like the English kind. It appears a very silly bird. A man on horseback, by riding round and round in a circle, or rather in a spire, so as to approach closer each time, may knock on the head as many as he pleases. The more common method is to catch them with a running noose, or little lasso, made of the stem of an ostrich's feather fastened to the end of a long stick. A boy on a quiet old horse will frequently thus catch thirty or forty in a day. The flesh of this bird, when cooked, is delicately white." In the Pampas the same traveller again met with Tinamous of two species, as large as hen-pheasants, which, with a partridge-like bird, Eudromia elegans, were the prey of a small species of fox seen in great numbers.

Mr. Swainson describes the species, of which our pictorial specimen is a representation, as being of a dusky rufous colour above, the head and neck dusky black; the chin white; the throat, neck, and breast cinereous; the under parts whitish; the flanks rufous black; the feathers margined with white; bill and irides red. Length eight and a quarter inches. It is a native of Bahia, and very rare, or common only in remote and select districts. It is the smallest of its tribe.

Family CRACIDÆ (CURASSOWS).

The Curassows (including the Guans and Hoatzins) are all natives of South America, and many approach the turkey in magnitude. The hind-toe, instead of being articulated high on the tarsus, as in Rasorial birds generally, is on a level with the rest, and adapts the feet for arboreal habits; legs spurless. The tail is ample, and composed of stiff feathers. In several species, as in the galeated curassow, the guan, the rasor-billed curassow, and others, the windpipe makes one, two, or even three deep folds between the skin and muscles of the breast before passing into the cavity of the chest. Berries and various sorts of grain constitute the food of these birds, and they are remarkable for tameness, becoming easily domesticated. Their flesh in delicacy and whiteness surpasses that of the fowl or pheasant.

In many parts of South America, says Mr. Bennett, these birds "have long been reclaimed, and it is really surprising, considering the extreme familiarity of their manners, and the facility with which they appear to pass from a state of nature to the tameness of domestic fowls, that they have not yet been introduced into the poultry-yards of Europe. That with proper treatment they would speedily become habituated to the climate, we have no reason to doubt; on the contrary, numerous examples have shown that they thrive well even in its northern parts, and M. Temminck informs us that they have been, once at least, thoroughly acclimated in Holland, where they were as prolific in their domesticated state as any of our common poultry. The establishment, however, in which this had been effected was broken up by the civil commotions which followed in the train of the French revolution, and the results of much labour lost by its complete dispersion."

1781.—THE CRESTED CURASSOW

(*Crax alector*). In the genus Crax the bill is very deep and arched above; surrounded at the base with a membrane. Lore naked; head crested; tail-feathers fourteen.

The crested curassow is a native of the forests of Mexico, Guiana, and Brazil; in Guiana particularly it is so abundant, that Sonnini regards it as an unfailing source of supply to the traveller who has to trust to his gun. These birds congregate together in large troops, and are so unsuspicious that they will remain quietly perched on the branches of trees whilst the gun makes havoc amongst their numbers. In districts, however, which are well frequented, they are more shy and mistrustful, ever keeping on the alert to avoid the pursuit of the sportsman. They build large nests on the trees, constructing them of sticks and long herbage, and lining them with grasses and leaves. The eggs are from five to eight in number, and resemble those of a fowl, but have a thicker shell and are of larger size. This species has bred in Holland, and is common in a domestic state in the Dutch settlements of Berbice, Essequibo, Demerara, and elsewhere; and requires but little care. In aviaries, according to our observations, it suffers, as do the rest of the group, from wet or damp, which occasions mortification and consequent loss of the toes. Plenty of room, a dry soil, with trees on which to perch, and a sheltered situation, are essentials in all endeavours to naturalize this valuable bird. In size the crested curassow equals a moderate turkey. With the exception of the abdominal region, which is white, the whole plumage is rich black with a gloss of green. The cere and skin round the eyes are bright yellow. The crest consists of feathers about three inches long, curled forwards, of a velvety appearance, and capable of being raised or depressed at will.

1782.—THE GALEATED CURASSOW

(*Ourax Pauxi*). Le Hooco du Mexique, Buffon.

In the genus Ourax the base of the upper mandible is dilated into a sort of horny elevated casque surmounting the top of the head.

The galeated curassow frequents in flocks the forests of Mexico, and perches on the trees, but, as is stated, makes its nest on the ground; and the young are led by the female parent, in the same manner as a hen leads her brood. The young are at first fed with worms, larvæ, and insects, and afterwards pick up grain, fruits, berries, &c. Like the preceding, this species is easily domesticated, and is one of those which bred in Holland in the menagerie of M. Ameshoff. Size, that of a small turkey. Head and neck covered with short velvety feathers of a deep black; all the rest of the plumage (with the exception of the feathers of the abdomen, which are white) brilliant black with a gloss of green: tail tipped with white; legs red; bill bright red.

1783.—THE CRESTED GUAN

(*Penelope cristata*). In the genus Penelope the bill is moderate and convex, with a naked basal skin and lore. Under the throat a naked skin capable of being inflated. Tail-feathers twelve.

The crested guan, called Jacu (pronounced Yacoo) in Brazil, as it is said from its cry, inhabits Guiana, Brazil, &c.; it tenants the woods, sometimes associated in large flocks, passing the greater portion of their existence on the topmost branches of the trees, where it builds its nest. They feed upon seeds and fruits, which, like the pigeons, they search for on the ground; and, as in the case of those birds, pair together with strict constancy. Their flight is heavy and laboured. Of their flesh, those who have partaken of it speak very highly. As the conformation of the trachea would lead us to suspect, the voice of these birds is loud and harsh, and when uttered by numbers in concert, resounds far through the woodland wilderness.

The crested guan has been bred in Holland.

In size this bird equals a fowl, but is longer, measuring thirty inches, of which the tail is fourteen. The whole of the upper surface is dusky brownish black, with a gloss of olive green. The head is surmounted by a tufted crest. The throat-fold of skin is scarlet; the naked cheeks are purplish; the chest is regularly spotted with dashes of white on a dusky brown ground, which latter colour prevails on the under surface. The female has a universal tinge of reddish, but in other respects resembles the male.

1784.—THE MOTMOT GUAN

(*Ortalida Motmot*). In the genus Ortalida the characters are the same as in Penelope, excepting that the head is completely feathered, and there are no naked throat-folds of skin. This species is found in Guiana, and agrees with the crested guan in general habits, but we know less respecting it than respecting other species of this family. Its general colour is reddish brown with a bronzy gloss above.

1785.—THE HOATZIN

(*Opisthocomus cristatus*). Hoatzin and Hoactzin of Hernandez; Houzin, Buffon.

In the genus Opisthocomus the bill is short, robust, and convex; the feet are large and strong; the tail-feathers ten.

The Hoatzin, which, according to Sonnini, is known in Guiana by the name of Sasa, was seen by Hernandez sitting on trees by the sides of rivers, and is said to prefer the flooded savannahs to higher grounds, and to live in pairs or small companies of six or eight individuals. It feeds much on the leaves of the Arum arborescens. The flesh of this species is not in high repute, and has a rank musky flavour and smell, whence probably medicinal properties have been attributed to it. The natives, according to Hernandez, deem this bird inauspicious. In gait and stature it bears much resemblance to the peacock.

Family MEGAPODIDÆ (MEGAPODES).

The birds of this family are peculiar to Australia and the Papuan Islands (New Guinea, &c.), and till Mr. Gould's personal researches in the former country brought their native habits and manners to light, nothing was known respecting them. We have made reference to the Eccaleobion, to the Egyptian egg-ovens, and to M. Réaumur's manure-pits for hatching eggs. In these birds, strange to say, we behold examples of instinct-directed oven-framers, for they do not incubate like other birds, but deposit their eggs in mounds of earth and vegetable matter which they have collected and amassed, and in which by the heat generated they are hatched. By the kindness of Mr. Gould we have been favoured with an inspection of these birds, their skeletons, young, and eggs. The skeletons, which have the characters of those of Gallinaceous birds, are very extraordinary, and are adapted to the eggs, which are of enormous size, those of the common Megapode exceeding the eggs of the swan. The eggs of Talegalla are smooth and white, about the size of those of the pelican; those of Leipoa and Megapodius are covered with a sort of epidermis, or sandy-coloured chalky layer, which is readily removed from the true shell beneath. With respect to the size of these eggs, the intent is evident—they are destined to imprison and afford nutriment to the chick till it has grown to a comparatively large size and acquired great strength; and when it breaks the strong shell, it emerges completely clad in perfect full-grown feathers, and works its way through the substance of the mound, in which the egg was deeply buried. The feet of these birds are of immense size and strength, and armed with strong rasorial claws; the wings are rounded.

1786.—THE WATTLED TALEGALLA, OR BRUSH-TURKEY

(*Talegalla Lathami*, Gould). New Holland Vulture, Latham; Catheturus Australis, Swainson; Meleagris Lindesargii, Jameson; Brush-Turkey of the Colonists; Weelah of the aborigines of the Namoi. The Wattled Talegalla is a native of various parts of New South Wales; in the dense brushes of Manning and Clarence it is plentiful; it was found in the scrubby gullies and sides of the lower hills that branch off from the great range into the interior, on the Brezi range to the north of the Liverpool Plains, and was abundant on all the hills on both sides of the Namoi. In its habits it is gregarious, moving about in small companies, like many other gallinaceous birds, and is at the same time very shy and distrustful. When it is disturbed, it readily eludes pursuit by the facility with which it runs through the tangled brush. If hard pressed, or where rushed upon by their great enemy, the native dog, the whole company spring upon the lowermost bough of some neighbouring tree, and, by a succession of leaps from branch to branch, ascend to the top, and either perch there or fly off to another part of the brush. They resort also to the branches of trees as a shelter from the sun in the middle of the day, a habit which Mr. Gould notices as greatly tending to their destruction; for the sportsman is enabled to take a sure aim, and the birds will allow a succession of shots to be fired till they are all brought down.

But the most remarkable circumstance connected with the economy of this bird is its nidification, for it does not hatch its eggs by incubation. It collects together a great heap of decaying vegetables as the place of deposit of its eggs, thus making a hotbed, arising from the decomposition of the collected matter, by the heat of which the young are hatched. Mr. Gould describes this heap as the result of several weeks' collection by the birds previous to the period of laying, as varying in quantity from two to four cart-loads, and as of a perfectly pyramidical form. This mound, he states, is not the work of a single pair of birds, but is the result of the united labour of many: the same site appeared to Mr. Gould to be resorted to for several years in succession, from the great size and entire decomposition of the lower part, the birds adding a fresh supply of materials on each occasion previous to laying.

"The mode," says Mr. Gould in continuation, "in which the materials composing these mounds are accumulated is equally singular, the bird never using its bill, but always grasping a quantity in its foot, throwing it backwards to one common centre,

and thus clearing the surface of the ground for a considerable distance so completely, that scarcely a leaf or a blade of grass is left. The heap being accumulated, and time allowed for a sufficient heat to be engendered, the eggs are deposited, not side by side, as is ordinarily the case, but planted at the distance of nine or twelve inches from each other, and buried at nearly an arm's depth, perfectly upright, with the large end upwards: they are covered up as they are laid, and allowed to remain until hatched. I have been credibly informed, both by natives and settlers living near their haunts, that it is not an unusual event to obtain nearly a bushel of eggs at one time from a single heap; and as they are delicious eating, they are eagerly sought after. Some of the natives state that the females are constantly in the neighbourhood of the heap about the time the young are likely to be hatched, and frequently uncover and cover them up again, apparently for the purpose of assisting those that may have appeared; while others have informed me that the eggs are merely deposited, and the young allowed to force their way unassisted. In all probability, as Nature has adopted this mode of reproduction, she has also furnished the tender birds with the power of sustaining themselves from the earliest period; and the great size of the egg would equally lead to this conclusion, since in so large a space it is reasonable to suppose that the bird would be much more developed than is usually found in eggs of smaller dimensions. In further confirmation of this point, I may add, that in searching for eggs in one of the mounds, I discovered the remains of a young bird, apparently just excluded from the shell, and which was clothed with feathers, not with down, as is usually the case.* The upright position of the eggs tends to strengthen the opinion that they are never disturbed after being deposited, as it is well known that the eggs of birds which are placed horizontally are frequently turned during incubation.

The same author relates that these birds, while stalking about the wood, frequently utter a loud clucking noise; and, in various parts of the bush, he observed depressions in the earth, which the natives informed him were made by the birds in dusting themselves. The stomach is stated by Mr. Gould to be extremely muscular; and he found the crop of one which he dissected filled with seeds, berries, and a few insects.

The composure with which these birds sit to be shot at, as above noticed, must, as Mr. Gould observes, lead to an early extinction of the race; an event, he remarks, much to be regretted, since, independently of its being an interesting bird for the aviary, its flesh is extremely delicate, tender, and juicy. There is no doubt that this species may be domesticated, and it would make a noble addition to those foreign denizens of the poultry-yard which enrich our homesteads and tables.

In the Talegalla the beak is robust and convex; the wings are moderate; the tail ample; the head and neck furnished with short hair-like feathers; the cheeks naked, and the front of the neck presents a carunculated naked skin, or sort of wattle, reminding us of that of the turkey. In the adult male the whole of the upper surface, wings, and tail are blackish brown; the feathers of the under surface blackish brown at the base, becoming silvery grey at the tip; skin of the head and neck deep pink-red, thinly sprinkled with short hair-like blackish brown feathers; wattle bright yellow, tinged with red where it unites with the red of the neck; bill black; irides and feet brown.

The female is about a fourth less than the male in size, but so closely the same in colour as to render a separate description unnecessary. She also possesses the wattle, but not to so great an extent. Size about that of a turkey. (Gould, 'Birds of Australia.') Fig. 1787 represents the Head and Foot of the Talegalla.

1788.—The Ocellated Leipoa

(*Leipoa ocellata*, Gould). Native Pheasant of the colonists; Ngow of the aborigines of the lowlands, and Ngow-oo of those of the highlands of Western Australia.

In this genus the beak is more feeble than in Talegalla, the head clothed with feathers and crested. Fig. 1789 represents the Head and Foot of Leipoa.

This species abounds in the country north of Perth (W. Austr.), and in the barren sandy plains of the interior, one hundred miles north and east of York. It was seen by Captain Grey at Gantheaume Bay, and, according to the natives, exists at King George's Sound. In size it is inferior to the Talegalla, more slender and more elegantly formed. According to the accounts, since confirmed, collected by Mr. John Gilbert from G. Moore, Esq., advocate-general, Mr. Armstrong, the aboriginal interpreter, and some of the more intelligent natives of Western Australia, the Ocellated Leipoa is a ground-bird, never taking to a tree except when closely hunted: when hard pursued, it will frequently run its head into a bush, and is then easily taken. Food generally consisting of seeds and berries. The note mournful, very like that of a pigeon, but with a more inward tone. Eggs deposited in a mound of sand, the formation of which is the work of both sexes. According to the natives, the birds scratch up the sand for many yards around, forming a mound about three feet in height, the inside of which is constructed of alternate layers of dried leaves, grasses, &c., among which twelve eggs and upwards are deposited, and are covered up by the birds as they are laid; or, as the natives express it, "the countenances of the eggs are never visible." Upon these eggs the bird never sits, but when she has laid out her lay, as the henwives say, the whole are covered up, when the mound of sand resembles an ant's nest. The eggs, which are white, and very slightly tinged with red, are hatched by the heat of the sun's rays, the vegetable lining retaining sufficient warmth during the night; they are deposited in layers, no two eggs being suffered to lie without a division. The natives, who are very fond of the eggs, rob these hillocks two or three times in a season: and they judge of the number of eggs in a mound by the quantity of feathers lying about. If the feathers be abundant, the hillock is full; and then they immediately open and take the whole. The bird will then begin to lay again, again to be robbed, and will frequently lay a third time. Upon questioning one of the men attached to Mr. Moore's expedition, he gave to Mr. Gilbert a similar account of its habits and mode of incubating; adding, that in all the mounds they opened, they found ants almost as numerous as in an ant-hill, and that in many instances that part of the mound surrounding the lower portion of the eggs had become so hard that they were obliged to chip round them with a chisel to get the eggs out; the insides of the mounds were always hot. Captain Grey ('Journal of Two Expeditions,' &c., 1841) saw one large nest composed of a heap of sand, dead grass, and boughs, at least nine feet in diameter and three in height, and had observed them even considerably larger. They occurred in dry and sandy spots, covered most densely with a dwarf species of Leptospermum, through which the traveller cannot without the greatest difficulty force a passage, if he chance to leave the beaten path. The plumage is as follows:—head and crest blackish brown; neck and shoulders dark ash-grey; fore part of neck from the throat to the breast with lanceolate feathers, which are black with a white stripe down the centre; feathers of the back and wings marked with three distinct bands of greyish white, brown and black near the tip of each, the marks assuming an ocellated form; primaries brown, with zigzag lines near the tip; under surface pale buff; flanks barred with black; tail blackish brown, broadly tipped with buff; bill black; legs blackish brown. (Gould, 'Birds of Australia.')

1790.—The Mound-making Megapode

(*Megapodius Tumulus*, Gould.) Jungle-fowl of the colonists of Port Essington; Ooregoorgā of the aborigines of the Coburg Peninsula. In the genus Megapodius the beak is slender, nearly straight, and much resembles that of a fowl; the head is crested; the toes are very large and robust, and the claws of great size and strength. Fig. 1791 represents the Head and Foot of Megapodius.

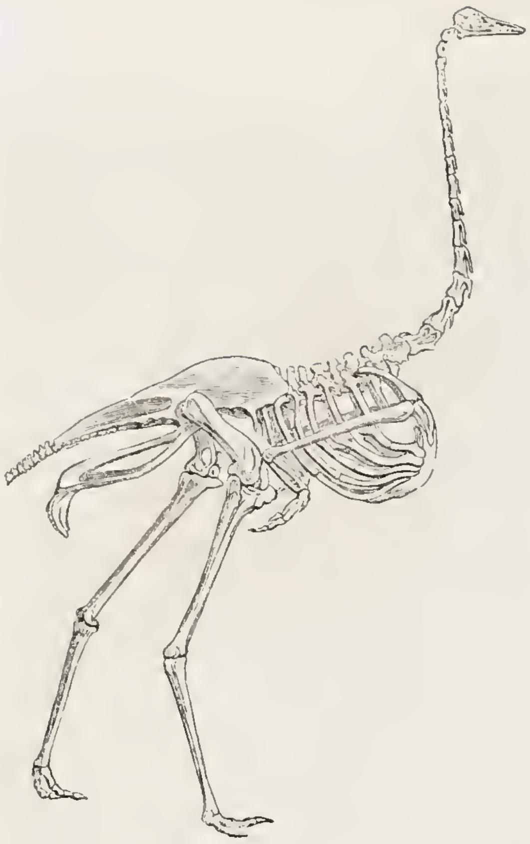
On Mr. Gilbert's arrival at Port Essington his attention was attracted to numerous great mounds of earth which were pointed out to him by some of the residents as being the tumuli of the aborigines. The natives, on the other hand, assured him that they were formed by the Jungle-fowl for the purpose of hatching its eggs. But this last statement appeared so extraordinary, and so much at variance with the general habits of birds, that no one in the settlement believed them, and the great size of the eggs brought in by them as the produce of this bird strengthened the doubt of the veracity of their information. Mr. Gilbert, however, knowing the habits of Leipoa, took with him an intelligent native, and proceeded about the middle of November to Knocker's Bay, a part of Port Essington harbour comparatively but little known, and where he had been informed a number of these birds were to be seen. He landed beside a thicket, and had not advanced far from the shore when he came to a mound of sand and shells, with a slight mixture of black soil, the base resting on a sandy beach, only a few feet above high-water mark: it was enveloped in the large yellow-blossomed Hibiscus, was of a conical form, twenty feet in circumference at the base, and about five feet high. On asking the native what it was, he replied, 'Oregoorgā Rambal' (Jungle-fowl's house or nest). Mr. Gilbert scrambled up the sides of it, and found a young bird in a hole about two feet deep; the nestling, apparently only a few days old, was lying on a few dry withered leaves. The native assured Mr. Gilbert that it would be of no use to look for eggs, as there were no traces of the old birds having lately been there. Mr. Gilbert took the utmost care of the young bird, placed it in a moderate-sized box, into which he introduced a large portion of sand, and fed it on bruised Indian corn, which it took rather freely. Its disposition was wild and intractable, and it effected its escape on the third day. While it remained in captivity, it was incessantly employed in scratching up the sand into heaps, and Mr. Gilbert remarks that the rapidity with which it threw the sand from one end of the box to the other was quite surprising for so young and small a bird, its size not being larger than that of a small quail. At night it was so restless that Mr. Gilbert was constantly kept awake by the noise it made in endeavouring to escape. In scratching up the sand the bird only employed one foot, and having grasped a handful as it were, threw the sand behind it with but little apparent exertion, and without shifting its standing position on the other leg.

Mr. Gilbert continued to receive the eggs without any opportunity of seeing them taken from the ground until the beginning of February, when, on again visiting Knocker's Bay, he saw two taken from a depth of six feet, in one of the largest mounds he had met with. In this instance the holes ran down in an oblique direction from the centre towards the outer slope of the hillock, so that although the eggs were six feet deep from the summit, they were only two or three feet from the side. "The birds," says Mr. Gilbert in continuation, "are said to lay but a single egg in each hole, and after the egg is deposited the earth is immediately thrown down lightly until the hole is filled up; the upper part of the mound is then smoothed and rounded over. It is easily known when a Jungle-fowl has been recently excavating, from the distinct impressions of its feet on the top and sides of the mound, and the earth being so lightly thrown over, that with a slender stick the direction of the hole is readily detected, the ease or difficulty of thrusting the stick down indicating the length of time that may have elapsed since the bird's operations. Thus far it is easy enough; but to reach the eggs requires no little exertion and perseverance. The natives dig them up with their hands alone, and only make sufficient room to admit their bodies, and to throw out the earth between their legs; by grubbing with their fingers alone they are enabled to follow the direction of the hole with greater certainty, which will sometimes, at a depth of several feet, turn off abruptly at right angles, its direct course being obstructed by a clump of wood or some other impediment. Their patience is however often put to severe trials. In the present instance the native dug down six times in succession to a depth of at least six or seven feet without finding an egg, and at the last attempt came up in such a state of exhaustion that he refused to try again; but my interest was now too much excited to relinquish the opportunity of verifying the native's statements, and by the offer of an additional reward I induced him to try again: this seventh trial proved successful, and my gratification was complete when the native, with equal pride and satisfaction, held up an egg, and, after two or three more attempts, produced a second: thus proving how cautious Europeans should be of disregarding the narrations of these poor children of nature, because they happen to sound extraordinary or different from anything with which they were previously acquainted."

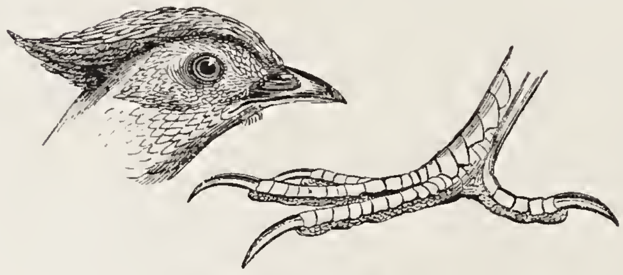
Upon another occasion Mr. Gilbert and his native, after an hour's excessive labour, obtained an egg from the depth of about five feet. It was in a perpendicular position. The holes in this mound (which was fifteen feet high and sixty in circumference at the base, and, like the majority of those that he had seen, so enveloped in thickly foliaged trees as to preclude the possibility of the sun's rays reaching any part of it) commenced at the outer edge of the summit and ran down obliquely towards the centre: their direction therefore, Mr. Gilbert observes, is not uniform. The mound was quite warm to the hands.

"The Jungle-fowl is almost exclusively confined to the dense thickets immediately adjacent to the sea-beach: it appears never to go far inland, except along the banks of creeks. It is always met with in pairs or quite solitary, and feeds on the ground, its food consisting of roots, which its powerful claws enable it to scratch up with the utmost facility, and also of seeds, berries, and insects, particularly the larger species of Coleoptera. It is at all times a very difficult bird to procure; for although the rustling noise produced by its stiff pinions when flying away be frequently heard, the bird itself is seldom to be seen. Its flight is heavy and unsustained in the extreme; when first disturbed it invariably flies to a tree, and on alighting stretches

* These points have been recently fully confirmed, and Mr. Gould has a series of the most valuable and interesting specimens, with details, which he has received from his intelligent and assiduous collector now in Australia.


1794.—Skeleton of Ostrich.


1790.—Mound making Megapode.


1791.—Head and Foot of Megapode.


1793.—Young of Megapode.


1792.—Duperrey's Megapode.


1796.—Ostriches.

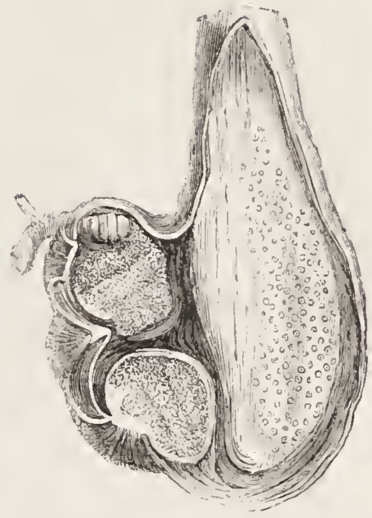

1795.—Skeleton of Apteryx.


1800.—Head and Tongue of Ostrich.


1799.—Head and Foot of Ostrich.

1801.—Stomach of Ostrich.

1808.—Stomach of Emeu.



1802.—Stomach of Ostrich, laid open.

1803.—Darwin's Rhea.

1798.—Ostriches.

1805, 1806.—Stomach of Nandu.

1797.—Ostrich carrying a Negro.

1804.—Foot of Rhea.

1807.—Foot of Emeu.

out its head and neck in a straight line with its body, remaining in this position as stationary and motionless as the branch upon which it is perched: if however it becomes fairly alarmed, it takes a horizontal but laborious flight for about a hundred yards with its legs hanging down as if broken. I did not myself detect any note or cry, but from the native's description and imitation of it, it much resembles the clucking of the domestic fowl, ending with a scream like that of the peacock. I observed that the birds continued to lay from the latter part of August to March, when I left that part of the country; and, according to the testimony of the natives, there is only an interval of about four or five months, the driest and hottest part of the year, between their seasons of incubation. ('Birds of Australia.')

The head and crest of the mound-making Megapode are of a deep cinnamon brown. The back of the neck and all the under surface dark grey. Back and wings cinnamon brown; tail-coverts dark chestnut; bill reddish brown. Tarsi bright orange, with the exception of the lower scales of the front, and those of the toes, which are dark reddish brown.

1792.—Duperrey's Megapode

(*Megapodius Duperreyii*). This species, the Mangoipe of the Papuans, inhabits the forests of New Guinea, and was found by Lesson near the harbour of Doréry; he observes that it is timid, runs fast among the bushes like a partridge, and utters a feeble cluck. Another species, the Manesaqué (M. Freyanetii), Lesson found common in the Island of Waigiou.

1793.—Alecthelia Urvillii of Lesson.

This bird, which Lesson not only regarded as a distinct species, but as the type of a distinct genus (on such unphilosophical grounds are genera now established), is nothing more than the young of the Megapodius Duperreyii: his specimen was procured from the Isle of Guebé under the equator.

ORDER CURSORES.

Illiger applies this title to a group of birds including the ostrich, rhea, cassowary, and also the bustards, plovers, stilt-plovers, and others: and so, according to our views, forms an order of heterogeneous materials. Cuvier, with better judgment, places the ostrich and its allies the emeu, cassowary, &c., in a distinct family group, which he calls "les Brevipennes," and which accords with the family "Struthionidæ" of M. Vigors, excepting that the latter includes in it the bustards. The order "Struthiones" of the Prince of Canino corresponds with the "Brevipennes" of Cuvier, the same order of Mr. G. R. Gray agrees with the family "Struthionidæ" of Vigors.

That the ostriches present us with a distinct type of form and anatomy from that exemplified either by the rasorial or grallatorial birds is palpable, and hence we place them under the title of an order *per se*, using the term Cursores, but excluding both the bustards and the plovers, &c. We are accustomed to look upon birds as denizens of the air, as endowed with the powers of flight; but in the birds of this order we see a marked exception to the general rule. They are strictly and exclusively terrestrial. They have wings it is true, but these organs are at their minimum of development, while, on the contrary, the limbs are massive, the bones large and stout, and the muscles acting upon them exceedingly voluminous. In fact the whole locomotive energy is thrown into the lower extremities, while the wings, little more than rudimentary, are utterly inadequate to raise the body from the ground. This disproportion may be seen in the Skeleton of the Ostrich, Fig. 1794, and still more so in that of the Apteryx, Fig. 1795, and with it we observe that the sternum or breast-bone is both diminished and otherwise modified. Our plan, however, forbids us to enter much into anatomical details: we shall therefore proceed at once to our first family.

Family STRUTHIONIDÆ (OSTRICH, RHEA, &c.).

The birds of this family, remarkable for the power of the lower extremities, their stature, and the loose texture of their plumage, are divided between Africa, South America, Australia, and the islands of the Indian Archipelago. Their appearance is striking; but their intelligence is not of a high order, rather, indeed, the contrary, though they are watchful and wary. Their food consists of vegetable matters, to which, in some species, insects, larvæ, worms, and other animal substances are added.

1796, 1797, 1798.—The Ostrich

(*Struthio-Camelus*, Linnæus). Στρουθοκάμηλος of the Greeks; Struthiocamelus of Pliny; Autruche of the French: Struzzo and Struzzolo of the Italians; Strauss of the Germans.

The genus Struthio is characterised by the beak being depressed, straight, rounded and unguiculate at the tip, with the nostrils longitudinal, prolonged half way down the bill, and open, the legs robust, with only two toes stout and strong, and connected at their base by a thick membrane; of these the innermost is much larger than the outer toe, and is furnished with a hoof-like claw, outer toe clawless; wings furnished with beautiful waving plumes, and two plumeless shafts not unlike a porcupine's quill; head and upper half of the neck scantily covered with thin down; eyes large and well guarded with eyelashes; tongue extremely small, short, and rounded. Fig. 1799 represents the Head and Foot of the Ostrich: Fig. 1800, the front view of the head, with the beak open to show the tongue.

The resemblance of the ostrich in many structural peculiarities to the ruminating quadrupeds was not overlooked by the ancients, which led them to assign to it the name of camel-bird, in allusion to certain points of analogy between it and the camel: indeed Aristotle asserts the ostrich to be partly bird and partly quadruped, and Pliny observes that it may be almost considered as belonging to the class of beasts. The voluminous thighs divested of feathers are more like those of a quadruped than a bird; added to which the bifid hoof-armed foot, well padded beneath, bears a marked resemblance to that of the camel. In this animal there is a large callous pad on the chest, upon which, when reposing, it throws a great portion of the weight of the body. In the ostrich the sternum, which has no keel, but is simply convex and shield-like, is also covered with a callous pad, or elastic cushion, having a hard rough surface unclothed with feathers, and on which the birds rest while reposing. The eyes, with their long lashes and overhanging brow, are also camel-like. The vast size and sacculated form of the proventriculus (or cavity before the muscular gizzard), with its extraordinary apparatus of glands for pouring out a solvent fluid capable of reducing the coarsest vegetable aliment, is not to be overlooked. (See Fig. 1801, the Stomach of the Ostrich; Fig. 1802, the same laid open.) Nor ought we to pass unnoticed the comparatively developed condition of the diaphragm, which muscular expansion in the Apteryx is complete.

Like the camel, this celebrated bird is destined to inhabit the wide-spread desert, beneath a burning sun. It is found in the sandy wilds of Arabia, and of Africa from the north to the south; everywhere avoiding the presence of man, who time immemorial has been its unrelenting persecutor.

In South Africa flocks of ostriches are often seen on the Great Karroo, in company with troops of quaggas, all amicably feeding together, and when alarmed scouring the desert with extraordinary rapidity. The swiftness of the ostrich is indeed very great; elevating itself and vibrating its expanded plumes, it leaves "horse and rider" far behind. In South Africa several horsemen, taking different sides of a plain, often manage to tire the bird down; but when driven to extremities it frequently turns infuriated on its pursuers, and will inflict dreadful wounds with its claw. Dr. Shaw gives an account of a person who was ripped open by the blow of an enraged ostrich, which was kept tame, and which, though gentle to persons with whom it was familiar, was fierce and violent towards strangers. ('Travels in Arabia.') In Arabia and North Africa the chace of the ostrich is accounted one of the most severe of exercises both for the Arab and his courser, requiring not only speed, but skill; and did the bird, instead of wheeling round in circles of greater or less extent, dart forward in a direct line, the hunter would find his efforts fruitless; as it is, he is generally enabled, after some exertion, to dash across the path of the bird, and throw his djerid or fire his gun. From the swiftness of the ostrich, and its power of endurance at full speed for hours, we may easily conceive that its strength must be very great. Adanson saw two tame ostriches at the factory of Podor on the south bank of the Niger. "They were both so tame," he says, "that two little blacks mounted together on the back of the largest, and no sooner did he feel their weight than he began to run as fast as ever he could, till he carried them several times round the village, and it was impossible to stop him otherwise than by obstructing the passage. To try their strength, I made a full-grown negro mount the smallest, and two others the largest. This burden did not seem to me at all disproportioned to their strength. At first they went at a moderate gallop; when they were heated a little, they expanded their wings as if to catch the wind, and then scoured along with such fleetness that they seemed not to touch the ground: they would have distanced the fleetest race-horses that were ever bred in England."

The ostrich is polygamous. "The male ostrich in South Africa, at the time of breeding," says a personal observer, "usually associates to himself from two to six females. The hens lay all their eggs together in one nest, this being merely a shallow cavity scraped in the ground of such dimensions as to be conveniently covered by one of these gigantic birds during incubation. The hens relieve each other during the day, and the male takes his turn at night, when his superior strength is required to protect the eggs or the new-fledged young from jackals, tiger-cats, and other enemies. Some of these animals are not unfrequently found lying dead near the nest, killed by a stroke from the foot of this powerful bird. As many as sixty eggs are sometimes found in and around an ostrich nest; but a smaller number is more common. Each female lays from twelve to sixteen eggs. They continue to lay during incubation, and even after the young brood are hatched; the supernumerary eggs are not placed in the nest, but around it, being designed (it is reported) to assist in the nourishment of the young birds, which, though as large as a pullet when first hatched, are probably unable at first to digest the hard and acrid food on which the old ones subsist. The period of incubation is from thirty-six to forty days. In the middle of the day the nest is often left by all the birds, the heat of the sun being then sufficient to keep the eggs at the proper temperature."

With respect to the passage in Job xxxix. 15, it may be observed, that within the torrid zone the eggs are merely laid in the warm sand, the incubation of the female being required only at night; so far, however, is she from neglecting her offspring, that she watches over them with as much solicitude as any other bird, hovering around the spot where they are deposited, and if surprised, making a short circuit and returning to the object of her care.

The flesh of the ostrich when young is very palatable, and the eggs are excellent. If, however, the bird perceives that the latter have been disturbed by the hand, or that the nest has been visited, she breaks them all and abandons the spot; hence the natives abstract these delicacies by means of a long stick, with the utmost caution, and endeavour to prevent the prints of their footsteps from being visible; if this be well managed, the hen will continue to lay for some time.

The food of the ostrich consists of the tops of shrubby plants, seeds, and grain; strange to say, however, it will swallow with indiscriminating voracity stones, sticks, pieces of metal, cord, leather, and other substances, which often occasion its destruction. A fine specimen in the gardens of the Zool. Soc. ultimately died in consequence of swallowing part of a parasol.

The voice of the ostrich is, under ordinary circumstances, a hoarse sonorous sort of chuckle, but it is said to utter, especially at night, a roaring so like that of the lion, as to deceive the Hottentots.

The young ostrich is covered with coarse mottled and striped plumage of a blackish brown and yellowish white; the feathers of the back having the shafts dilated into a thin horny strip.

The height of the adult male is from seven to eight feet or more, standing upright. The beautiful plumes which are so valued in commerce are procured from the wings and tail.

Great as is in modern days the slaughter of ostriches, in the times of the Roman emperors it must have been far more considerable. We read of the brains of six hundred having been on one occasion served up in a single dish; and Vopiscus is said to have devoured an entire ostrich (a chicken doubtless) at one sitting.

By the Mosaic law the ostrich was forbidden as food, and the Arabs still regard it as unclean.

1803.—Darwin's Rhea

(*Rhea Darwinii*). In the genus Rhea the bill much resembles that of the ostrich, but is smaller, and the head and neck are completely feathered; the wings are furnished with plumes and terminated by a hooked spur. The feet are three-toed, the middle toe being much the largest, and are armed with stout claws. This genus is peculiar to South America. Fig. 1804 represents the Foot of the Rhea.

Two species of Rhea are now known, of which one, the Rhea Darwinii, has been but recently introduced to science. The other, long known, is the Nandu or Nhandu-Guaçu of the Brazilians; the Tuiju of Lacépède: Struthio Rhea of Linnæus (Rhea Americana, Temminck). By travellers it is often called "ostrich." The wings of this species are more developed than in the true ostrich, and are adorned with long slender plumes—those answering to the quill-feathers are white. The plumes of this bird are imported into England as an article of commerce, and are often seen fixed in a handle, so as to form light and delicate dusting-brushes. In its natural attitude the Nandu stands about five feet high: its general colour is greyish brown intermingled ith black passing into a lighter tint on

the under parts; the base of the neck is encircled by black, which spreads on the chest into a transverse semilunar mark. Though common in its native country, it is only within the last few years that specimens existed either in our museums or menageries, and, indeed, it is not long since that naturalists reckoned it among doubtful species. Azara states that it abounds upon the borders of the river La Plata, and is generally seen in the open parts in pairs, though sometimes in flocks of thirty. It is chased by horsemen, who capture or kill it with bolas, or thongs of leather with stones attached to the ends, which are very effective weapons. To our knowledge of the habits of this bird Mr. Darwin has recently made important additions. He describes it as abounding on the plains of La Plata, and as occurring occasionally in Paraguay. To the south its limit appears to be from forty-two to forty-three degrees. "It has not," he says, "crossed the Cordilleras, but I have seen it within the first range of mountains on the Uspallata plain, elevated between six and seven thousand feet." Its food consists of roots, grass, &c., but at Bahia Blanca Mr. Darwin repeatedly saw "three or four come down at low-water mark to the extensive mud-banks, which are then dry, for the sake, as the Gauchos say, of catching small fish." It is shy, wary, and fleet, but easily falls a prey to the Gauchos, who appear at different points around it, and so confuse it that it does not know which way to take, and is soon struck by their bolas. It prefers to run against the wind. It is a singular fact that the nandu takes to the water and swims well. Mr. King informed Mr. Darwin that in Patagonia, at the bay of San Blas, and at Port Valdes, he saw these birds swimming several times from island to island; little of their bodies appeared above the surface, and their progress was slow; and on two occasions Mr. Darwin saw them swimming across the Santa Cruz river, four hundred yards wide, with a rapid current. The note uttered by the male bird is a deep-toned hissing. It appears that the male alone incubates the eggs, and that several females lay in one shallow excavation, the total number of eggs varying from twenty to fifty. But besides the eggs deposited together in the nest, others, called by the Gauchos "huachos," are found scattered in great numbers over the plain, where they lie and become putrid. This circumstance, which appears strange, may arise, as Mr. Darwin suggests, "from the difficulty in several females associating together, and in finding a male ready to take the office of incubation." It is evident there must at first be some degree of association between at least two females, otherwise the eggs of each would be deposited at distances far too great to allow of the male collecting them into one nest. Previous then to the association of two or more females, the eggs they lay are dropped over the plain; but when the partnership takes place, they make a common nest.

The Rhea Darwinii (Fig. 1803), or Avestruz Petise, as the Gauchos call it, and which was evidently known to Dobrizhoffer (Account of the Abipones, 1749), is considerably smaller than the preceding species, inhabits Southern Patagonia, and about Rio Negro advances upon the border-line of the nandu; it is, however, rare there. At Santa Cruz Mr. Darwin saw several: "They are," he says, "exceedingly wary. I think they could see a person approaching when he was so far off as not to distinguish an ostrich. In ascending the river few were seen, but in our quiet and rapid descent many in pairs or by fours or fives were observed. It was remarked by some of the officers, and I think with truth, that this bird did not expand its wings when first starting at full speed, after the manner of the northern kind." It takes to the water like the nandu, and is said to prefer the plains near the sea, taking the place in Southern Patagonia of the nandu of northern Patagonia and the plains of La Plata. An imperfect specimen, shot at Port Desire, Patagonia, lat. 48° (the only one, we believe, in Europe), brought home by Mr. Darwin, is preserved in the museum of the Zool. Soc. The French naturalist M. d'Orbigny, when at Rio Janeiro, made great exertion to procure specimens of this bird, but did not succeed. A half-bred Indian informed Mr. Darwin that more than one female lays her eggs in a single nest, but the total number of eggs seldom amounts to more than fifteen. Mr. Darwin picked up eggs of the Avestruz Petise on the plains of Patagonia, and observes that they are little less than those of the common species, but of somewhat different form, and with a tinge of pale blue. For minuter details we refer to Mr. Darwin's 'Journal,' p. 105-110.

Fig. 1805 represents the Stomach of the Nandu; Fig. 1806, the same laid open to show the gastric glands.

1807.—EMEU, FOOT OF

(*Dromaius Novæ Hollandiæ*). Dromaius Australis, Swainson; Emu, New Holland Cassowary; Parembang of the natives.

In the genus Dromaius the bill is straight, with the edges depressed, slightly carinated above; head feathered; throat nearly naked; feet three-toed, very robust.

The emeu is a native of New Holland, and also the west coast near Swan River; Captain Flinders found these birds in abundance at Port Phillip and King George's Sound; and Flinders and Péron saw them in numbers on Kangaroo Island.

This species nearly equals the ostrich in bulk, but is lower on the legs, shorter in the neck, and more thickset in the body. In its native regions it is said to stand six or seven feet, when its head is fairly raised, and we have seen fine males in England of nearly the same magnitude. The wings are simple rudiments, destitute of plumes, and hidden beneath the feathers of the body; these have loose barbs; each feather consists of two plumes, the accessory plume, which is usually very short, being greatly elongated. As the feathers lie loosely hanging on the bird, they resemble hair; the cheeks and throat are nearly naked: the general colour is dull brown, but the skin of the cheeks and throat is purple.

The sound which the emeu utters is very singular; it is a hollow inward drumming, effected by a peculiar structure of the windpipe;—to the lower portion of this is added a membranous sac, communicating with the windpipe by means of a fissure, and consequently capable of being distended with air; and the compression of this air, so as to force a portion of it through the orifice into the windpipe, at intervals, doubtless occasions the sound.

The emeu breeds freely in captivity in our climate: the female lays from seven to eleven eggs, which are of a beautiful deep green, very hard-shelled, and nearly as large as those of the ostrich. The office of incubation is performed by the male, who sits with great assiduity. The young, when hatched, are clothed with a thick downy plumage, of greyish white colour, with two stripes of black down the back, two down each side, and two broken stripes down the fore part of the neck and breast.

In its native country the range of the emeu, owing to the advance of colonization, is more limited than formerly; it, however, abounds still in the plains beyond the limits of the colony of New Holland, and on Kangaroo and King's Islands.

Timid and peaceful, the emeu trusts alone to its speed for safety, excepting indeed when hard pressed; it then strikes violently with its legs: it is chased by dogs, and the course is said to afford, to those who delight in such recreation, excellent sport. We learn from Mr. Cunningham, that few dogs, except such as are specially trained, can be brought to attack it, both on account of some peculiar odour in the flesh which they dislike, and because when driven to extremity it defends itself with great vigour, striking out with its feet, and inflicting terrible wounds: the settlers, he observes, assert that "it will break the small bone of a man's leg by this sort of kick." To avoid being struck, the dogs, if properly trained, will run up abreast, and make a sudden spring at the neck, and if successful, they then soon dispatch the game. The eggs of the emeu are highly esteemed for food, and the flesh of the young is extremely delicate: that of the full-grown birds is coarse; it is, however, eaten both by the natives and the colonists, who often prefer it to kangaroo. "The rump part," says Mr. G. Bennett ('Wanderings,' &c.), "is considered as delicate as fowl; the legs are coarse, like beef, but still tender. The fibula bone of the leg is used as an ornament by the natives." It is, however, principally for the oil obtained from it that the emeu is valued. Of this fluid the skin of a full-grown bird produces six or seven quarts; it is clear, and of a bright yellow or amber colour. This oil is extracted by boiling the skin, stripped of the feathers, and cut into small pieces. It is used for burning in lamps, and various purposes. The natives prefer their emeu meat with the skin on, regarding the oil as a luscious treat.

Though these birds are shy and wary, they take but little pains in the concealment of their nest, which is very simple, consisting of a few sticks, leaves, and grasses, scraped together upon a clear space amidst brushwood. The natives seek for the eggs, which during the season of breeding form a great portion of their subsistence.

The food of this bird consists of leaves, fruits, and herbage, for the plucking of which its straight strong beak, which is rounded at the point, is well adapted.

Though not an aquatic bird, the emeu swims well; it has been observed by Captain Sturt crossing the Murrumbidgee River; and though we are not aware that either the ostrich or the cassowary ever enters the water and swims (a circumstance, especially as far as the latter is concerned, not improbable), we know that this is the case with the Rhea.

That the emeu might become naturalized in Europe, forming an ornament to our parks and pleasure-grounds, no one who has seen the specimens in the Gardens of the Zoological Society of London can hesitate to admit.

There is, besides the common emeu, a distinct species, of which one specimen exists in the Linnæan Collection, the other in the Museum at Paris. It is the Dromaius parvulus of Gould. It is very rare, if indeed it be not extirpated. Fig. 1808 represents the Stomach of the Emeu.

1809, 1810.—THE CASSOWARY

(*Casuarius Casoar*, Brisson). Emeu of the early Portuguese voyagers; Casoaris of Bontius. This fine bird, the sole example of the genus Casuarius, is a native of Java, Sumatra, Banda, and the Moluccas. The beak, instead of being broad and depressed, as in the ostrich, is compressed laterally, and ridged above; the head and upper part of the neck are naked, the former being surmounted with a horny crest or helmet, the latter being of the most intense blue, purple, and scarlet blended together; there are two wattles at the lower part of the neck. The body is covered with long, narrow, blackish feathers, rather stiff and glossy, and having a coarse, hair-like appearance. The pinions are very small, and concealed beneath the plumage, with the exception of fine long, stiff, and pointed shafts, of a black colour; their length is unequal; the longest exceeds twelve inches.

The thighs are clothed with feathers, and the toes are three in number, of which the innermost, which is short, is armed with an enormous conical claw. Height of bird when erect, about five feet. In many important points of internal structure the cassowary differs from the ostrich; in fact, it is not a desert bird, though fleet and powerful: its digestive organs are not adapted for hard coarse diet, but for fruits and tender succulent herbage. It is not common even in its native islands, where, however, it is sometimes kept tame. It defends itself by striking violently with its feet, turning itself obliquely, and kicking backwards at its enemy. Cuvier says that it strikes also with its wing-shafts. It is bold and resolute, but by no means intelligent. This bird is much inferior in size to the ostrich; but it is robustly built, and very strong. Bontius remarks that the eggs are very different from those of the ostrich, by reason of their thinness and colour, for their shell is greenish, ornamented with deeper-tinted numerous tubercles. They are eaten by the natives. Cuvier says that the cassowary, like the ostrich, abandons its eggs, and that they are hatched by the heat of the climate. Fig. 1811 represents the Head and Foot of the Cassowary; Fig. 1812, the Skull of the Young Cassowary, before the osseous helmet, which increases with age, has begun to be elevated; Fig. 1813, the Skull of the Adult Cassowary, with the horny helmet (which during life is encased with horn) greatly developed.

Family APTERYGIDÆ (APTERYX).

This family is limited, as far as we yet know, to New Zealand.

1814.—THE APTERYX

(*Apteryx Australis*). Kiwi-kiwi of the natives of New Zealand.

New Zealand presents us with the Apteryx, or Kiwi-kiwi, so extraordinary a bird, and so anomalous in its conformation, that the existence of a species possessing such a combination of characters has been denied. The original specimen, namely, that described by Shaw, and for many years the only one extant in Europe, is in the cabinet of the Earl of Derby. It was brought home in 1812, by Captain Barclay, of the ship Providence. Within the last few years, however, since New Zealand has been visited by intelligent Europeans, several other specimens have been received; and among them one complete bird, preserved in brine, which has enabled Professor Owen to give a most elaborate account of its anatomy (published in the second vol. of the 'Trans. Zool. Soc.'), accompanied with admirable engravings. (See also 'Proceeds. Zool. Soc.' 1838.)

The apteryx stands about two feet in height. Its wings are trifling rudiments, buried beneath the general plumage of the body, and not to be discovered without difficulty; they are each terminated by a little hooked claw.

The beak is long, slender, and slightly arched, reminding one of that of the curlew. The upper mandible is somewhat swollen and notched at its tip, and a longitudinal furrow runs along each side from the base to the extremity. The situation of the nostrils is most extraordinary; they are minute narrow fissures, one on each side of the tip of the beak; and therefore not situated as in other birds which insert their long beaks into mud for the purpose of procuring insects, and which have the nostrils at the base. The limbs are extremely powerful; the tarsi are thick and short, and covered with hard scales. The toes are four in number; the three anterior toes are robust, with strong claws, and are well adapted for digging. The hind toe is a thick,

1816.—Foot of Apteryx.

1815.—Bill of Apteryx.

1814.—Apteryx.

1810.—Cassowaries.

1813.—Skull of Adult Cassowary.

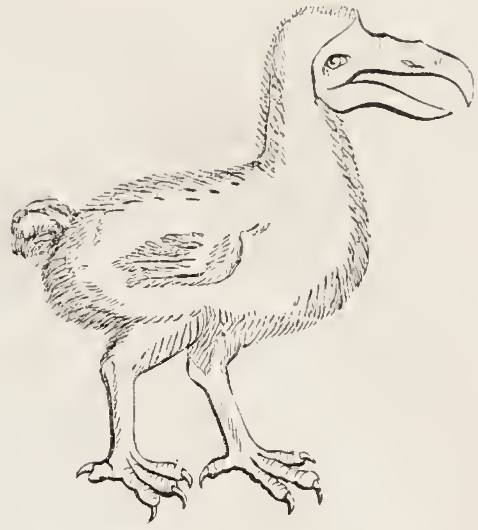
1812.—Skull of Young Cassowary.

1809.—Cassowary.

1811.—Head and Foot of Casso

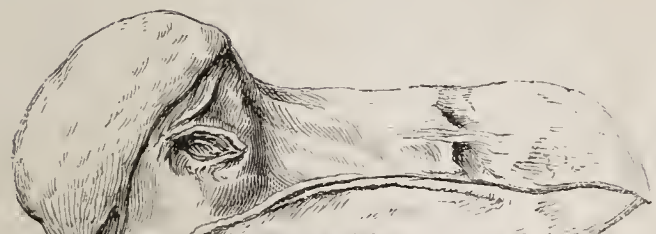
1821.—Dodo, from Bontius.

1820.—Dodo, from Herbert.



1819.—Dodo, from Clusius.

1817.—Dodo.



1823.—Head of Dodo, at Oxford.

1818.—Dodo, from De Bry.

1824.—Foot of Dodo, in British Museum.

1822.—Le Solitaire, from Leguat.

sharp, horny spur, used as an offensive weapon. There is no vestige of a tail. The tongue is short and simple.

The feathers are long and lanceolate, and fall loosely like those of the emeu, but there is only a single plume from each quill. These feathers are of a chestnut brown, margined on each side with blackish brown; the tint of those on the under parts is lighter. The eye is small, and a number of long bristle-like hairs are scattered around and about the angles of the mouth. The bill is of a horn colour, or yellowish, like a piece of cane.

It is principally in the southern parts of the middle island of New Zealand that this bird is to be met with, though it exists wherever suitable localities afford it shelter,—these are extensive beds of fern, among which it conceals itself. When chased it takes refuge in the clefts of rocks, in hollow trees, or in deep holes which it excavates in the ground; these holes are its breeding-places, and conduct to a deep chamber, in which the apteryx makes a bed of fern for the eggs, but neither the number nor the colour of these is satisfactorily determined, nor do we know any particulars respecting their incubation.

The food of this strange bird consists of insects, and particularly worms; in order to procure the latter it disturbs them by striking with its feet and bill on the ground, and seizes them the instant they make their appearance; it will also thrust its bill into soft soil and draw them out, swallowing them whole. Night is the season of activity, the apteryx being nocturnal in its habits, and the natives are accustomed to hunt it by torch-light: they value it greatly for the sake of its skin, which they prepare with the feathers on. Dresses made with these skins (which are singularly tough and firm) are prized by the chiefs, who can rarely be induced to part with them.

When the apteryx is undisturbed and quietly resting, says Mr. Short in a letter to Mr. Yarrell ('Trans. Zool. Soc.' 1833), the head is thrown back upon the shoulders, the bill pointing to the ground. When pursued, it elevates the head, like an ostrich, and runs with great swiftness. When overtaken, it defends itself with spirit and vigour, and inflicts dangerous blows with its strong spur-armed feet.

Such is the sum total of our knowledge of the habits of this bird, which seems doomed to become, at no distant date, exterminated from the limited portion of the globe which alone forms its habitat. A beautiful figure is given of it by Mr. Gould, in the second part of his 'Birds of Australia and New Zealand.'

Fig. 1815 represents the Bill of the Apteryx; Fig. 1816, the Foot of the same bird.

Family DIDIDÆ (DODO).

This family contains only one established genus, Didus; and the only species, as far as we can ascertain, included in it, is extinct.

1817.—The Dodo

(*Didus ineptus*). Dronte, Bontius; Walgh-Vögel of the Dutch mariners, according to Clusius; Dod-aers of the Dutch, and Dod-eersen; Solitario of the Portuguese; Gallus gallinaceus peregrinus, Clusius; Cygnus cucullatus, Nieremberg.

Till the discovery, in 1505, of the islands now called Bourbon, Mauritius, and Rodrigue (but first termed the Mascarenhas Isles, from the name of the Portuguese navigator who discovered them), they appear never to have been occupied as a residence by man; perhaps no human foot had ever trod their shores, no human voice broken the stillness of their woodland solitudes. In these islands for ages had the dodo existed undisturbed, at least by the great marauder, by whom at last its race was to be extinguished.

It appears, indeed, if the species be the same, that the dodo was at one time not confined to those islands, and that it was, previously to 1505, known to the Portuguese mariners under the name of Solitario; for Vasco de Gama, in 1497, after doubling the Cape of Storms (the Cape of Good Hope), found an island near a bay (Angra de San Blaz) where solitaries were plentiful, and again in 1499 touching at the same place, the crew took a number of them. The sailors compared these birds to swans, and called the island "Ilha des Cisnes," or Isle of Swans. In 1614 Castleton visited Bourbon; there he found the dodo abundant, and so tame as to allow itself to be killed with sticks or stones. He had also met with the bird in Mauritius, where they are, as he states, in great plenty, and known by the name of giants. The island of Rodrigue, which, though previously known, had perhaps not been visited, being surrounded by coral reefs, and also being destitute of secure anchorage, was examined by Leguat in 1691, who, with several companions, remained some time with a view to colonization. He there found the dodo, which he terms Solitaire, or the solitary, because it never congregates in flocks, though it is very abundant. He gives some particulars respecting it, which agree in the main with those detailed in 'Herbert's Travels,' published in 1634, and accompanied by a figure.

"The males have generally a greyish or brown plumage, the feet of the turkey, and also the beak, but a little more hooked. They have hardly any tail, and their rump, covered with feathers, is rounded like the croup of a horse. They stand higher than the turkey-cock, and have a straight neck, a little longer in proportion than it is in that bird when it raises its head. The eye is black and lively, and the head without any crest or tuft. They do not fly, their wings being too short to support the weight of their bodies; they only use them in beating their sides, and in whirling round." The females he states to be of a blond or pale brown colour: they build a nest with leaves of the palm-tree on a clear spot of ground, laying only one egg, larger than that of a goose. The weight of the males is forty-five or fifty pounds, and the flesh is, as he says, a delicacy. In this description one important point is omitted, that is, the hooded character of the head, well expressed in the account alluded to in Herbert's Travels. Leguat's figure is either very bad or his solitaire is distinct from the dodo.

In the Voyage to the East Indies, by Jacob van Neck and Wybrand van Warwÿk, 1598, the dodo is noticed as inhabiting the island of Cerne (Mauritius); and De Bry, in his description of the island of Cerne, says, "Cerulean parrots abound there, as well as other birds; besides which is another kind, of large size, exceeding our swans, with vast heads, and one half covered with a skin, as it were, hooded. These birds are without wings, in the place of which are three or four black feathers. A few curved, delicate, ash-coloured feathers constitute the tail. These birds we called Walck-Vögel, because the longer or more slowly they were cooked, the worse they were for eating. Their breasts and bellies were nevertheless of a pleasant flavour, and easy of mastication; but another cause for the appellation we gave them was the preferable abundance of turtle-doves, which were of a far sweeter and more grateful flavour." De Bry gives a figure in his frontispiece. Clusius, in his 'Exotica,' 1605, gives a figure of this bird, taken from a sketch *ad naturam*, by a Dutch voyager, who had seen the bird in 1598. In the 'Voyage of Jacob Heemskirk and Wolfert Harmansz to the East Indies in 1601, 1602, 1603,' and in Willem Ysbrantsz Bontekoe van Hoorn's 'Journal of the East India Voyage, &c., in 1618 to 1624,' the dodo is noticed as inhabiting the Mauritius. Herbert, in his 'Travels,' 1634, describes and figures the dodo; it is also described and figured well by Bontius, 1658. To this catalogue of authorities more might be added—but we will not weary our readers. Among the many descriptions of the bird by travellers and writers of credit, we will content ourselves with that of Bontius. "The Dronte, or Dod-aers," he says, "is for bigness of mean size between an ostrich and a turkey, from which it partly differs in shape and partly agrees with them, especially with the African ostriches, if you consider the rump, quills, and feathers; so that it was like a pigmy among them, if you regard the shortness of its legs. It hath a great, ill-favoured head, covered with a kind of membrane resembling a hood; great black eyes; a bending, prominent, fat neck; an extraordinary long, strong, bluish-white bill, only the ends of each mandible are of a different colour, that of the upper black, that of the nether yellowish, both sharp-pointed and crooked. It gapes huge wide, as being naturally very voracious. Its body is fat, round, covered with soft grey feathers, after the manner of an ostrich's: in each side, instead of hard wing-feathers or quills, it is furnished with small, soft-feathered wings, of a yellowish ash-colour; and behind, the rump, instead of a tail, is adorned with five small curled feathers of the same colour. It hath yellow legs, thick, but very short; four toes in each foot, solid, long, as it were scaly, armed with strong black claws. It is a slow-paced and stupid bird, and which easily becomes a prey to the fowlers. The flesh, especially of the breast, is fat, esculent, and so copious, that three or four dodos will sometimes suffice to fill an hundred seamen's bellies. If they be old, or not well boiled, they are of difficult concoction, and are salted and stored up for provision of victual. There are found in their stomachs stones of an ash colour, of divers figures and magnitudes; yet not bred there, as the common people and seamen fancy, but swallowed by the bird; as though by this mark also nature would manifest that these fowl are of the ostrich kind, in that they swallow any hard things, though they do not digest them." (Willughby's Transl.)

There is some reason to believe that a living dodo was exhibited in England in 1638. (See Sloane's MSS., No. 1839, 5, p. 108, Brit. Mus.)

In the British Museum is preserved a painting of this bird, the copy of an original which was taken from a living specimen sent to Holland from Mauritius, while this island was held by the Dutch. This copy was the property of Sir Hans Sloane, and afterwards of Edwards, by whom it was deposited in the Museum. As it agrees with other figures, namely, one in Clusius, one in Herbert's 'Travels,' and one in Willughby's 'Ornithology,' taken from Bontius, we have every reason to rely upon it as an accurate representation. Formerly a perfect specimen, noticed by Ray, existed in Tradescant's Museum. This specimen afterwards passed into the Ashmolean Museum at Oxford, where it still existed as late as 1700; it subsequently fell to decay, the head and a foot alone remaining. A foot of this bird is preserved in the British Museum, and a breastbone in the Museum at Paris.

We have now before us a cast of the head in the Ashmolean Museum, and a most extraordinary head it is: there is something greatly vulture-like in the whole of its conformation. For example, as we find in the vultures, it was evidently capable of being retracted within a hood or duplicature of skin thinly covered with downy feathers; the beak is stout, deep, and powerful, considerably elongated, and strongly hooked at the tip; its base is covered with an extensive cere, at the termination of which, near the edge of the upper mandible, are the nostrils; the gape is wide, extending beyond the eye; the skin of the throat was loose and thinly clothed, and the top of the head appears to have been naked, or only sprinkled with feathers. The measurements are as follows:—from the eye to the end of the beak, six inches; to the nostril, three inches; breadth of the skull across the forehead, three inches and a quarter; mean depth of beak, two inches and a quarter. Though we say the head is vulture-like in its contour, we would guard ourselves from the assertion that it was to the vulture family the dodo belonged, as M. Blainville and some naturalists contend: other parts of its structure, to judge from the painting and the descriptions of early travellers, militate against such a supposition. Cuvier refers it to the gallinaceous order. Unfortunately we have no means of coming to a positive conclusion; but our impression is that it forms part of the group or order to which the true ostriches and apteryx also belong.

Suddenly, and apparently about the middle of the seventeenth or beginning of the eighteenth century, the dodo disappeared. Nothing was heard of it; and we only know that it does not now exist in the islands which abundant testimony proves it to have once inhabited. It is, in fact, extinct; or, if it indeed survive, Madagascar is the most likely spot in which it lingers. We know, indeed, little of Madagascar, and have been recently astonished by the discovery of a species of monkey (Cercopithecus albogularis) inhabiting certain districts of that island, which modern naturalists have strenuously asserted to be destitute of any true Simiæ.

In concluding this brief notice of the dodo we refer our readers to a paper by Mr. Duncan in the 'Zoological Journal,' which contains an admirable summary of its history.

The following are figures of the dodo from different works:—Fig. 1818, the Dodo, from De Bry; Fig. 1819, the same, from Clusius; Fig. 1820, the same, from Herbert; Fig. 1821, the same, from Bontius; Fig. 1822, le Solitaire, from Leguat; Fig. 1823, the Head of the Dodo, from a cast from the Oxford specimen; Fig. 1824, the Leg of the Dodo, from the specimen in the British Museum. Tarsus four inches and a half; circumference four inches; middle toe three inches.

The subjoined letter from Professor Owen to Mr. Broderip is published in the 'Penny Cyclopædia.' It is too important to be omitted:—

"Whilst at the Hague," writes the Professor, "in the summer of 1838, I was much struck with the minuteness and accuracy with which the exotic species of animals had been painted by Savery and Breughel in such subjects as 'Paradise,' 'Orpheus charming the Beasts,' &c., in which scope was allowed for grouping together a great variety of animals. Understanding that the celebrated menagerie of Prince Maurice had afforded the living models to these artists, I sat down one day before Savery's 'Orpheus and the Beasts,' to make a list of the species which the picture sufficiently evinced that the artist had had the opportunity to study alive. Judge of my surprise and pleasure in detecting in a dark corner of the picture (which is badly hung between two windows) the Dodo, beautifully finished, showing for example, though but three inches long, the auricular circle of feathers, the scutation of the tarsi, and the loose structure of the caudal plumes. In the number and proportions of the toes, and in general form, it accords with Edwards's oil-painting in the British Museum; and I conclude that the miniature must have been copied from the study of a living bird, which it is most probable formed part of the Mauritian menagerie.

"The bird is standing in profile, with a lizard at its feet. Not any of the Dutch naturalists to whom

I applied for information respecting the picture, the artist, and his subjects, seemed to be aware of the existence of this evidence of the dodo in the Hague collection.

"I think I told you that my friend Professor Eschricht of Copenhagen had written to inform me that the skull of a dodo had been lately discovered in the museum at Copenhagen: it had before formed part of the museum of the Duke of Gottorp."

In Nov. 1839, Professor Owen, at a meeting of the Zool. Soc., exhibited the thigh-bone of an extinct bird of the struthious order, from New Zealand; since which period he has received numerous additional specimens and almost entire skeletons, proving that several races of birds (five distinct species), one of which was of gigantic stature, have till a comparatively recent period existed in that island, where the apteryx, their pigmy representative, is soon, perhaps, about to follow their fate. The bones are not truly fossilized, but still contain much animal matter. At a recent meeting of the Zool. Soc., Professor Owen brought the specimens in question before the scientific world, and entered into elaborate details respecting their anatomical peculiarity. To the extinct genus of birds in question he gave the title of Dinornis. Of the five presumed species, three were respectively named D. giganteus, D. struthioïdes, and D. didiformis; of these the first must have stood at least ten feet six inches in height, and probably more. They appear to have been all wingless. Professor Owen assigns the extinction of these birds to a period shortly after the occupation of New Zealand, perhaps till then untrodden by the foot of man, by the Malay race, of which the New Zealanders are an offset, and as these birds presented to the wanderers (driven perhaps on the coasts of that island by storms) the only large animals which could serve as food, he argues, with much reason, that the improvident extinction of these birds, and the consequent failure of food, led to that practice of cannibalism for which the New Zealanders have been notorious. The preservation of the apteryx, after the destruction of its relatives (for they belonged to the family Apterygidæ), he justly attributes to its much smaller size, but especially its nocturnal and burrowing habits. (November, 1843.) We have here, then, within human records, perhaps two species of Dodo and five of Dinornis obliterated by the agency of man from the catalogue of living animals.

ORDER GRALLATORES.

THE word Grallatores, which literally means Stilt-walkers, is synonymous with the French term les Echassiers, which Cuvier has given to the present order, and which is in truth very applicable to the birds in general comprehended in it. It has by many naturalists been termed the Wading order, a title which is correct as respects the greater number of groups, but not all. The birds of this order, says Cuvier, are characterized by want of feathers at the lower part of the thighs and the elevation of the tarsi, two circumstances which permit them to wade to a certain depth without wetting their plumage, and thus to procure fish by means of their neck and beak, the length of which is generally proportionate to that of the legs. Such as have the beak strong live on fish and reptiles; those in which it is feeble, on worms and insects. A few feed partially on grains and herbage, and these live at a distance from water, frequenting open plains, downs, and extensive commons. The order Grallatores is very extensive, and contains a variety of forms, from the bustards, to the snipes and rails, differing no less in habits and instincts than in external and internal characteristics.

Family OTIDÆ (BUSTARDS).

The bustards are peculiar to the Old World, Europe, Asia, and Africa, and have the body stout, the wings moderate or ample, the neck and legs long, the beak short, conical, and compressed; three short stout toes entirely united at their base, but no hind-toe. They frequent wide plains, extensive downs, and open lands dotted with patches of shrubby vegetation. Their food consists of tender herbage, grain, and insects. They run with extreme rapidity, and, unless closely pursued, seldom take wing; when obliged to rise, their flight is direct and rapid. They are shy and watchful, and not to be approached without some difficulty. In their habits they are polygamous. The females quit the society of the male previous to laying eggs, and they make their nest and incubate alone. The moult of these birds is stated to take place twice in the year. The males not only exceed the females in size, but are distinguished by a richer style of colouring. The young males of the year resemble the females, and the adult males, it is believed, lose in winter their ornamented livery, and nearly resemble the females.

1825, 1826, 1827.—THE GREAT BUSTARD

(*Otis Tarda*). Outarde of the French; Starda of the Italians; Der grosse Trappe, Trappgans, and Akentrap of the Germans; Abutarda of the Spaniards; yr Araf Ehedydd of the Welsh. (Fig. 1827, Female.)

This noble bird, which was once common in our island, is now rarely to be seen, except, we believe, in the western part of Norfolk; it is true that it occasionally makes its appearance on the wide plains and commons, in various parts of the country, as Salisbury plain, Newmarket heath, and North Stow heath in the neighbourhood of Bury St. Edmunds, but unfortunately its presence attracts observation, and observation in such a case is generally followed by active measures conducing to its destruction. In Spain and the plains of Greece, in some parts of Russia, and on the wilds of Tartary, it is common; it is occasionally seen in some parts of France, very rarely in Italy.

The male bustard weighs from twenty-five to thirty pounds, and measures about three feet three inches in length. The female seldom exceeds one-third of the size of the male. Grain, various grasses, the tender leaves and sprouts of turnips, insects, worms, frogs, &c. constitute their food. In the adult male there exists a membranous pouch beneath the skin on the fore-part of the neck, having an entrance to it under the tongue; it is of considerable capacity, being capable, according to Pennant, of containing seven pints of water: it has been, indeed, supposed by some that the use of this sac is for carrying a supply of water, either for its own use or that of the female and her young; but as the male takes no care of the brood, and as no water has ever been found in this pouch, this supposition is untenable. Its use, in fact, is not known.

The bustard runs very swiftly, and we have accounts of its having been chased by dogs, which we can readily credit, because a good greyhound would press so hard as not to allow the bird the time of preparation for taking wing, should he come upon it by surprise. On the other hand, however, we agree with Mr. Selby, who says, "Upon being disturbed, so far from running in preference to flight, as has been often described, it rises upon wing with great facility, and flies with much strength and swiftness, usually to another haunt, which will sometimes be at the distance of six or seven miles. It has also been said that in former days, when the species was of common occurrence, it was a practice to run down the young birds, before they were able to fly, with greyhounds, as affording excellent diversion. So far from this possibility existing with respect to the present remnant of the bird, the young birds upon being alarmed constantly squat close to the ground, in the same manner as the young of the lapwing, golden plover, &c., and in this position are frequently taken by the hand: indeed, this is even the habit of the female at the time of incubation."

In the 'Booke of Falconrie' (1611) the bustard is mentioned as affording what was termed the "great flight," together with the crane, wild goose, bittern, heron, &c., a proof in favour of Mr. Selby's observation, that it gives preference to the wing when alarmed. In the winter the bustard associates in small flocks, which traverse the country in search of food, and visit turnip-fields for the sake of the leaves, to which they are very partial; in severe weather they seek sheltered situations, and often resort to the maritime districts. The eggs of the bustard are two in number, as is usual with the birds of this family; the female forms no definite nest, but deposits them on the ground in a slight depression made to receive them, generally in extensive corn-fields; they exceed in size those of the turkey, and are of a pale brownish olive, with darker blotches. Incubation lasts four weeks, and the young as soon as excluded follow their parents, but are unable to take wing for a considerable period. As an article of food the flesh of the bustard is in high estimation; it is dark in colour, short in fibre, and of fine flavour. In its wild state the bustard is very shy, so as not to be approached within gun-shot, unless with great caution: it always selects for its place of repose the centre of the largest inclosure, or, if the country be open, that part of the plain where it will be most secure from the danger of a surprise. Those which have been kept in confinement, though tolerably tame towards persons with whom they were familiar, have exhibited both distrust and ferocity towards strangers. All attempts to breed these birds in captivity have failed.

In the male bustard, from each side of the cheeks, near the lower mandible, arises a tuft of long wiry feathers with loose barbs. The fore part of the neck over the pouch is destitute of feathers, the skin being bluish black. The head and back of the neck are bluish grey; a longitudinal streak of black occupies the top of the head. The upper surface is of a fine orange buff, barred with zigzag transverse markings of black; under parts white, a tinge of yellow occupying the chest. Tail white at the base, passing into yellowish brown, with one or two black bars.

The female is destitute of the moustache-feathers, and the head and neck have a deeper tint of grey than in the male. Gular pouch wanting.

1828.—THE BLACK-HEADED BUSTARD

(*Otis nigriceps*). This fine species is a native of India, and is very generally spread: it occurs in the Himalaya Mountains, and is figured by Mr. Gould in his 'Century of Birds' from that elevated chain. According to Colonel Sykes, it is so common in the Dukhun, "that one gentleman has shot nearly a thousand." It is gregarious, and the male is furnished with the remarkable gular pouch found in the Otis Tarda. Its flesh is excellent. The food of this species was found by Colonel Sykes to consist almost exclusively of grasshoppers. In the male the body above is of a pale bay, lightly undulated with rufous brown. Neck, a few spots on the wings and under parts, white. The head, which is crested, the outer wing-coverts, the quills, and a large mark on the breast, black. Length fifty-six inches and a half. The female resembles the male in plumage, but is only forty-one inches and a half in length.

1829.—THE LEADEN-TINTED BUSTARD

(*Otis cærulescens*). This species is a native of the plains of South Africa, where it was discovered by Le Vaillant. Its habits and manners are those of the family generally. The summit of the head is marked with black and reddish zigzags, straight, and nearly approximated. Above the eyes extends a large whitish band, punctured as it were with brown; plumes near the ear-opening of a clear ruddy colour. Under the neck a semicircular band of pure white; and below, another twice as large, of deep black. Front of the neck, breast, and all the other lower parts of a lead colour. All the upper parts of the body of a reddish or yellowish brown, marked with black zigzags and dots very near together. Lower coverts of the wings and tail-feathers unspotted, ruddy. End of the tail black, tinged with brown. Quills black. Feet yellowish green. Bill brown, yellow at the base. Length twenty inches; height, when erect, seventeen inches six lines.

1830.—THE KORI BUSTARD, HEAD OF

(*Otis Kori*). This magnificent bird is a native of Southern Africa, and was found by Burchell on the banks of the Gariep. "We shot," he says, "a large bird of the bustard kind, which was called Wilde Paauw (Wild Peacock). This name is here very wrongly applied, as the bird to which it properly belongs differs from this in every respect. There are, indeed, three or perhaps four birds to which, in different districts, this appellation is given. The present species, which is called Kori in the Sichuana language, measured, in extent of wing, not less than seven feet, and in bulk and weight was almost greater than some of the people could manage. The under part of the body was white, but the upper part was covered with fine lines of black on a light chestnut-coloured ground. The tail and quill-feathers partook of the general colouring of the back; the shoulders were marked with large blotches of black and white, and the top of the head was black; the feathers of the occiput were elongated into a crest, those of the neck were also elongated, loose, narrow, and pointed, and were of a whitish colour marked with numerous transverse lines of black. The irides were of a beautiful pellucid, changeable, silvery, ferruginous colour. Its body was so thickly protected by feathers that our largest-sized shot made no impression; and, taught by experience, the hunters never fire at it but with a bullet. It is reckoned the best of the winged game in the country, not only on account of its size, but because it is always found to abound in fat. The meat of it is not unlike that of a turkey, but is certainly superior as possessing the flavour of game."

We may here mention the Otis Tetrax and the Otis Houbara as European species of this group; the former of rare occurrence in our island, the latter as rare within the borders of Europe, but common in Barbary, Arabia, Persia, &c., where the natives employ hawks in the chace of it, and enter with enthusiasm into the sport. (See vol. i. p. 270.) In India, where there are several species, these bustards are commonly termed Florikens.

Family CHARADRIADÆ (PLOVERS).

In this comprehensive group the legs are long, the toes short, the hinder generally wanting or minute, and the wings long and powerful. Sandy unsheltered shores and exposed commons or moors are their chief haunts; they congregate in flocks, and run with great swiftness: the head is thick; the eye full and large; the bill short, with the basal half soft, the apex often swollen: the habits often


1827.—Great Bustard. Female.


1830.—Head of Kori Bustard.

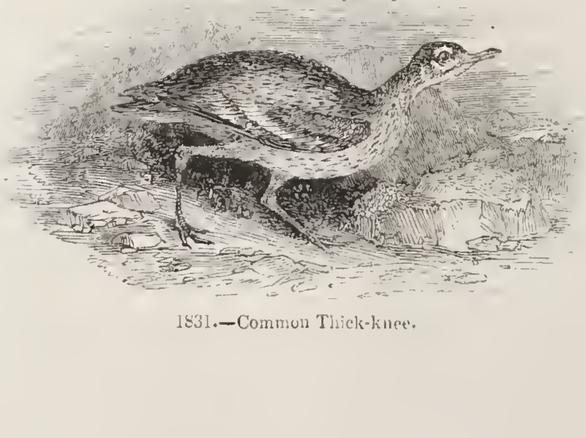

1829.—Leaden-tinted Bustard.


1828.—Black-headed Bustard.

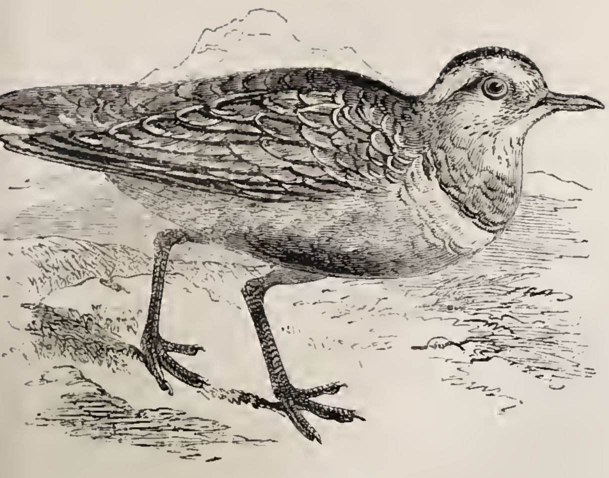

1825.—Great Bustard.


1826.—Great Bustard. Male.


1833.—Head and Foot of Thick-knee.


1831.—Common Thick-knee.

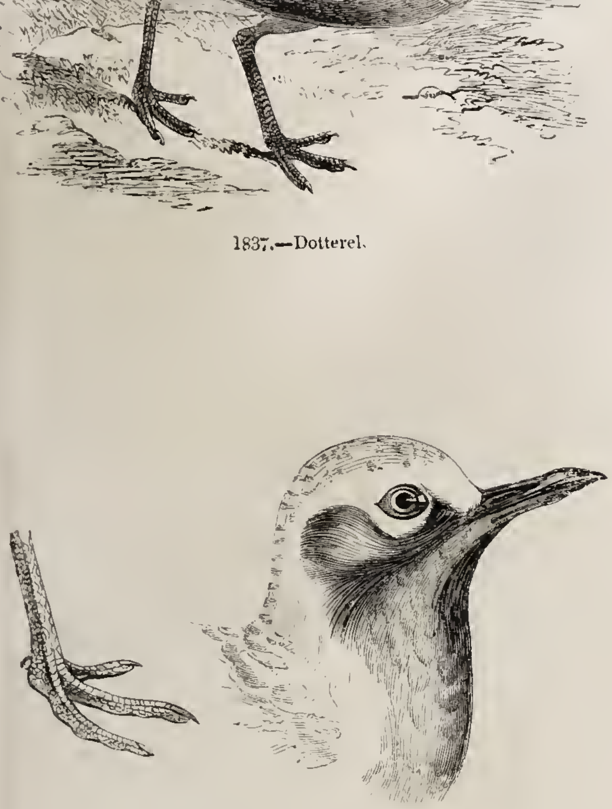

1832.—Common Thick-knee.



1837.—Dotterel.

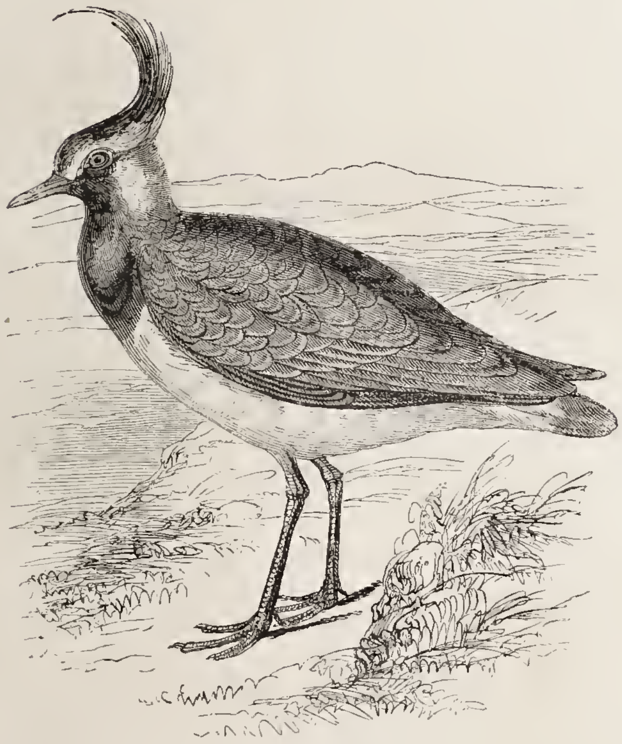
1842.—Head and Foot of Lapwing.

1844.—Turnstone.

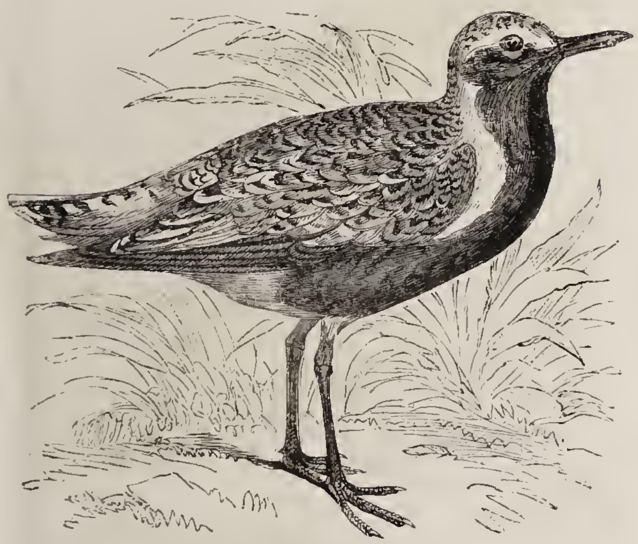


1840.—Head and Foot of Grey Plover.

1836.—Head and Foot of Golden Plover.



1841.—Lapwing.



1838.—Grey Plover.

1834.—Golden Plover.

1843.—Spur winged Plover.

1839.—Grey Plover.

1835.—Golden Plover.

nocturnal. The number of eggs laid by the females is generally four, sometimes two. Most are subject to a spring and autumn moult, and the summer livery differs from that of winter.

1831, 1832.—THE COMMON THICK-KNEE

(*Œdicnemus crepitans*). Le grand Pluvier ou Courlis de Terre of the French; Gran Pivieri, Curlotte, Ciurluì, and Ciurlovì of the Italians; Grosser Brachvogel of the Germans: y glin-Braff of the Welsh; Thick-kneed Bustard, Stone-Curlew, and Norfolk Plover of English writers.

Wide downs and commons, uplands, and sheep-walks are the favourite resorts of this bird, where it makes its appearance in March or April, in small flocks, which are very shy, flying round in wide circles if disturbed from their repose. They run along very nimbly, with the head poked forwards; and squat amongst loose stones and the irregularities of broken ground, where the colour of the objects about favours their concealment. In Hampshire, Norfolk, Suffolk, Sussex, &c. this bird is tolerably common. In Germany, as in England, it is migratory. It is found in Southern Europe, generally in India, North Africa, Egypt, the Greek Archipelago, and Turkey.

Though the Thick-knee is wary and watchful by day, and readily takes alarm, this is in reality its resting time, and it is at night that it rouses up in pursuit of food. As the dusk of evening approaches, it begins to utter its loud piping note, and trips over the dewy grass, picking up worms, insects, and young frogs, which form its chief diet. The Thick-knee, like the bustard, makes no nest, but deposits its eggs, two in number, on the bare earth, in fallow land or spots of ground where flint stones are scattered about, spotting as it were the earth, and favouring the concealment of the female and her progeny, whose plumage assimilates with the chequered and mottled appearance of the surface which she has selected. The eggs are of a light yellowish brown, with darker streaks and blotches. The young after exclusion immediately follow their parents, and are then covered with a mottled grey down, which gradually gives place to the proper plumage, and in six weeks or two months they are capable of flying and of providing for themselves.

In the autumn, after the breeding season, the flocks which had scattered themselves in pairs over the downs, and the young they have reared, assemble all together, forming larger or smaller flocks, and prepare to take their departure, quitting our latitudes for a more congenial climate; and in October few if any are to be seen in the localities previously tenanted, and where at night their loud call had resounded "familiar to the shepherd's ear."

The general plumage of this bird is of a reddish ash above, each feather having a central streak of umber brown; neck and chest yellowish white, streaked with umber brown; throat and under parts white; quills black; base of the bill bright yellowish; naked skin round the eyes; iris and legs fine yellow. Length sixteen inches.

In the genus Œdicnemus the bill is strong and nearly straight; the nostrils longitudinal, and pierced through and through the horny part of the middle of the upper mandible; the tarsi long, and thick at the joints; the toes are three, all before, and united as far as the second joint by a membrane which skirts their edges; wings rather ample. Mr. Gould considers that this genus connects the plovers to the bustards. Five or six species are known. Fig. 1833 represents the Head and Foot.

1834, 1835.—THE GOLDEN PLOVER

(*Charadrius pluvialis*). In the genus Charadrius the bill is slender, straight, compressed, and shorter than the head; the nasal furrow is prolonged, and the mandibles are enlarged towards the tip. Toes three, all directed forwards, and the external united to the middle by a short membrane. Eyes large, nocturnal.

Fig. 1836 represents the Head and Foot of Charadrius.

The Golden Plover (Pluvier doré of the French) is a bird of passage, spread over Europe, Western Asia, and portions of North Africa. In North America its place is supplied by an allied species (Ch. Virginiacus, Borkh), and by the C. marmoratus in the eastern parts of Asia.

Though the golden plover breeds in the British Isles, it is only to be found in the southern districts during the winter, at which season the numbers of our native birds are increased by arrivals from more northern latitudes—all, be it observed, clad in their wintry livery, which differs remarkably from that of the summer.

Heathy swampy moors and wild hilly districts are the haunts of this species, where it breeds; its nest consists of a few fibres and stems of grass, placed in some depression of the ground amidst the heath. The eggs, four in number, are of a cream yellow, with a tinge of green, blotched and streaked with umber brown. The young, when first excluded from the egg, are covered with a beautiful parti-coloured down of bright king's yellow and brown. They are very active, and follow the parents, who sedulously attend them, and not only display great anxiety in their protection, but put in practice the most ingenious artifices in order to draw off man or dog from the spot where they lie crouched; they will flutter along as if lame, and unable to take wing, a few feet before the intruder, and attracting his attention, give him as it were hopes of soon being able to effect a capture, till having effected its object, up it mounts, leaving him to gaze "in silent wonder lost." In the same manner they protect their eggs, the female always running to a considerable distance from the nest, and even meeting the intruder, long before he would approach the spot, before employing her parental stratagems. The young are able to fly in a month or five weeks, and joining other broods, with their parents form large flocks, which quit the hilly districts of the north, and make their way to the open downs bordering our southern coasts. About the beginning of April the flocks return northwards, gradually breaking up, and at last resolving into pairs, which soon fix upon a breeding-spot. The cry of the plover is a plaintive monotonous whistle, more varied in the breeding season, by the imitation of which the bird may be enticed within a short distance. The flight of this species is rapid and vigorous, and during the spring and summer generally at a great elevation; while it sails round and round performing most graceful evolutions. Night is the feeding-time. When reposing during the day, the plover rests either crouched on the ground or standing on one leg with the head drawn down between the shoulders. Insects and their larvæ, slugs, worms, &c., constitute their diet, for which they frequent fallow lands in the autumn, becoming very fat, and are highly esteemed as one of the luxuries of the table. In the southern countries of Europe this species winters in countless multitudes. In autumn and winter the London markets are abundantly supplied with golden plovers.

The summer plumage of this species, assumed in spring, is of a deep black above, each feather having triangular marginal spots of golden yellow; forehead and space above the eyes pure white, as are also the sides of the neck and chest, but spotted with black and yellow; throat, front of the neck, and under parts deep black. As winter comes on the black of the neck and under parts is lost; the upper surface is sooty black, largely varied with fine golden yellow; the sides of the head, neck, and chest are varied with ashy brown and yellowish spots; throat and under parts white. Length ten inches and a half. Fig. 1834, Summer dress; Fig. 1835, Winter dress.

1837.—THE DOTTEREL

(*Charadrius Morinellus*). Le Pluvier guignard of the French; der Dumme Regempfeifer of the Germans; Piviere tortolino of the Italians.

Though the Dotterel certainly breeds on the Grampians, on Skiddaw, and other mountains in the northern portion of our island, yet it must be considered rather in the light of a visitor to our shores than a permanent resident; its great breeding-places are the high latitudes of Russia, Lapland, and Northern Asia. It breeds also on the bare plateaux of the Norwegian mountains, and in Bohemia and Silesia, at an elevation of four thousand eight hundred feet.

The eggs are light olive brown, blotched and spotted with black.

In the autumn vast flocks of the dotterel on their way from the north to the warmer regions of southern Europe visit our island, and a similar visit is paid in spring by the flocks on their return from the south to their northern breeding-places.

With respect to its general habits, the dotterel closely agrees with the golden plover; it has been accused, indeed, of excessive stupidity—but for no other reason than because, fresh from the wilds untrodden by man, it has not experienced persecution. Its flesh in the autumn is excellent. It undergoes a change of plumage analogous to that of the golden plover.

1838, 1839.—THE GREY PLOVER

(*Squatarola cinerea*). In the genus Squatarola we see the rudiment of a hind-toe; the tarsi are reticulated. Nasal groove wide. Fig. 1840 represents the Head and Foot of Squatarola.

The grey plover is the Vanneau varié, Vanneau gris, and Vanneau Pluvier of the French.

The plumage of this species undergoes a similar change to that of the golden plover, and indeed so much do the two birds resemble each other, that were it not for the presence of a minute hind-toe in the grey plover, and for the long black feathers which are found underneath the wings near the body, one might be easily mistaken for the other. The grey plover is spread over all the temperate countries of Europe, and Asia during the winter, retiring in summer to the regions of the arctic circle to breed. It has been observed in Japan. It is also common in North America, breeding in the far countries of the north. According to Dr. Richardson it is the Toolee-areeo or Tooglie-aiah of the Esquimaux. Captain J. Ross found it breeding near the borders of the marshes in considerable numbers, immediately to the south-west of Fury Point. This species visits our island, but not in great numbers, during its southward migration in autumn, and upon its return northwards in spring, and a few small flocks sometimes remain with us during the winter, frequenting oozy bays and the mouths of rivers along the coast. Worms, insects, small shell-fish, and crustacea, with various berries in summer, constitute its food. The flight is powerful and circling; it also runs with great celerity; its cry is similar to, but not quite so shrill as that of the golden plover. The flesh is excellent, and in high esteem. It is the Tringa Helvetica of Linnæus; Squatarola Helvetica of Gould; and the Charadrius Africarius of Wilson. The young is the Tringa varia of Linnæus. A second species, Squatarola cincta, was brought by Captain P. P. King, R.N., from the Straits of Magellan.

1841.—THE LAPWING

(*Vanellus cristatus*). Le Vanneau of the French; Paoneella of the Italians; Gehaübte Kieboz of the Germans; De Kievit of the Netherlanders; Wype, Peesweep, and Peewit, Provincial English; Cornchwigel of the Welsh. Fig. 1842 represents the Head and Foot.

In the genus Vanellus the hind-toe is more developed than in Squatarola, and the head is ornamented either with a crest, or with fleshy wattles and protuberances about the base of the beak, as in many foreign species; many also have the earpal joint of the wing armed with a sharp spur, often of considerable length. "These birds," says Selby, "are the inhabitants of open grounds and plains, particularly where the soil is of a moist nature, feeding on worms, insects, larvæ, &c. They are subject to the double moult, but their vernal change of plumage is not attended with any remarkable difference of colour." The wings are ample.

The geographical distribution of the lapwing is very extensive; it is spread over the whole of Europe and a great part of Asia; it occurs in collections from India, North Africa, and Japan. In our island it is abundant wherever moorland tracts invite its abode. Here it breeds, depositing four eggs in a loose nest made with a few straws or stalks of grass, in a slight depression of the ground. The eggs are of a fine olive green blotched and marked with brownish black. Great numbers of these, known as "plovers' eggs," are annually brought into the London market, and, being accounted delicacies, sell at a good price. They are collected in Norfolk, Lincolnshire, and Cambridgeshire. When the female is driven from her eggs, she runs for a considerable distance, and then flies low near the ground, uttering not a single cry: in the mean time the male flies round the intruder and clamorously reiterating the syllables *pee-weet*, endeavours by various arts to draw off his attention from the female, and the spot where the nest is placed. When first hatched the young are covered with a parti-coloured down of yellow and brown, and follow their parents, who not only defend them with courage against birds of prey, but employ every stratagem to divert men or dogs from their retreat, feigning lameness, and fluttering and tumbling in the path before them. When the autumn commences, the lapwings assemble in vast flocks, composed of old birds and the young of the year; and as the cold sets in, gradually withdraw from the inland moorlands, visiting the districts near the sea and the mouths of rivers; frequenting fallow-lands, turnip-fields, and low oozy grounds, where, in the more southern parts of our island, they appear to remain all the year, unless the mid-winter be a season of more than usual severity, when they pass still more southward. In February or the beginning of March these birds revisit the moorlands, and scatter abroad in pairs. At this season their flight is very singular: they perform a variety of fantastic evolutions (more especially the males), sometimes darting upwards, then suddenly sweeping downwards, and describing an abrupt and mazy course with many turnings; during this flight of exultation they incessantly utter a variety of notes very different from their monotonous melancholy *Pee-weet*, while the loud whizzing of their long pinions is distinctly audible.

In the autumn the flesh of the peewit (or wype, as it is called in the 'Northumberland Household-Book') is excellent, but, as might be expected, it is dry in the summer. Mr. Selby considers it to be the bird called Egret (from its crest or aigrette), of which one thousand were served up at the famous feast of Archbishop Nevil. Slugs, worms, and insects constitute the diet of this bird, for the destruction of

which it is sometimes kept in gardens, and becomes very tame. The lapwing is very beautiful. The head is black glossed with green, and an elegant crest of long slender black feathers, turned slightly upwards, rises from the occiput; the throat is black; the upper parts are greenish black with purple and blue reflexions; the chest and under parts are white; the tail is white at the base, then black, with white at the tip. Length thirteen inches.

1843.—THE SPUR-WINGED PLOVER

(*Pluvianus spinosus*, Gould). Charadrius spinosus, Linn.; Philomachus spinosus, Mæhr; Holopterus spinosus, Bonaparte.

In this genus (whichever name be adopted) the legs are long, slender, and naked a great distance above the tarsal joint; there is no hind-toe, and the external and middle are united by means of a basal membrane; wings very long and pointed, and armed with a sharp spur.

This species is common in Greece, Egypt, and Senegal. It is occasionally seen in Italy; it occurs in some parts of Russia, and is abundant in the neighbourhood of Aleppo. It is a noisy bird, and, as Latham says, is continually moving the head and neck as if making repeated bows. The top of the head is black, and furnished with a rather short occipital crest, capable of being depressed or raised at will. The upper surface is greyish brown; the greater coverts are white; the quills black; the sides of the face and neck, the back of the latter, the flanks, the thighs, the tail-coverts and base of the tail are white; the part of the neck from the bill, and the chest, under parts, and terminal half of the tail are jet black. Length eleven inches.

1844.—THE TURNSTONE

(*Strepsilas Interpres*). Tringa Interpres, Linn.; Morinella collaris, Meyer; Strepsilas collaris.

We agree with those naturalists who place the genus Strepsilas within the family Charadriadæ, and not among the Scolopacidæ, with their finger-tipped bills. In Strepsilas the beak is of moderate length, strong, compressed, acutely pointed, and slightly turned upwards; nasal depression elongated; wings acuminate; hind-toe very small.

There is not a part of the globe, from Nova Zembla and the shores of the Arctic to the Cape of Good Hope, from the shores of Hudson's Bay to the straits of Magellan, which is not visited by this species,—Japan, Sunda, the Moluccas, New Guinea, and New Holland, Europe, Asia, Africa, constitute its range. It breeds in the high northern latitudes, in Norway and Sweden, and also, it is said, in the Shetland Isles; in June and in August it begins its southern progress, returning northwards in spring. Mr. Hewitson found its nest on the coast of Norway placed against a ledge of rock, and consisting of nothing more than the fallen leaves of the juniper-bush, under a creeping branch of which the eggs, four in number, were concealed. Their colour was of an olive-green spotted and streaked with ash-blue, and two shades of reddish brown. In our island the turnstone is found from August to March or April; it frequents the rocky and gravelly shore, feeding upon small molluscous animals, crustacea, &c., in quest of which it turns over the stones along the water's edge, by means of its hard bill: it trips quickly along, and flies with great power and rapidity. In its progress to maturity the turnstone undergoes several transitions of colour before acquiring a permanent livery. When in perfect plumage the upper parts are of mingled black and rufous; a black gorget on the chest passes up the sides of the neck and round the base; lower part of the back white, as is also the basal half and extreme tip of the tail, the intermediate part being black; a semilunar mark of dark feathers separates the white of the lower part of the back from the white tail-coverts; under surface white; a white spot between the eye and base of the beak is very conspicuous; legs orange-yellow. Length nine inches.

1845.—THE OYSTER-CATCHER

(*Hæmatopus ostralegus*). L'Huiterier, Pie de Mer, and Bécasse de Mer of the French; Beccacio di Mare of the Italians; Geschackte Austernfischer of the Germans; Piogen y Môr of the Welsh; Sea Pie, Pianet, Olive, Sea Woodcock, Chalder, &c., provincial English.

In the genus Hæmatopus the bill is long, hard, compressed, especially at the point, which is abrupt and chisel-like, but not pointed; nostrils longitudinal; legs strong; toes three, all directed forwards, bordered by the rudiment of a membrane; and the external and middle toes united by a partial web at the base.

The oyster-catcher is distributed over the whole of the European continent and a great part of Asia and Africa, frequenting the sea-shore, and is common on the low flat coasts of our island, where it breeds, laying its eggs on the bare ground amidst the shingle, or such herbage as grows above high-water mark. The eggs, four in number, are pale olive-green blotched with brownish black. During incubation the male is always on the watch, and on the approach of an intruder utters a loud shrill whistle, as an alarm-call, upon which the female silently quits her eggs, and runs to a considerable distance before taking wing. Limpets, which it easily detaches from the rock, mussels, oysters, and other mollusks constitute its food, in quest of which it wades amongst the shallows, or swims, which it does very easily, where the depth forbids wading. In the autumn, after the young have acquired their full growth, these birds assemble in large flocks, which separate into pairs on the recurrence of spring. The parents are bold in the defence of their young, which run about as soon as hatched, under the care of the former. In America the oyster-catcher is represented by an allied species, the H. palliatus, Temminck (H. ostralegus, Wilson). The oyster-eatcher is a beautiful bird. The general plumage is glossy velvet black, with the exception of the lower part of the back, the base of the tail, transverse bars on the wings, and the under parts, which are white; bill and circle round the eyes orange-red; irides crimson; legs deep purplish red. In winter there is a collar of white on the throat, and the black is less brilliant.

1846.—THE COLLARED PRATINCOLE

(*Glareola torquata*). In many points the genus Glareola exhibits a great similitude (not affinity) to the swallows: the wings are long and pointed; the tail is forked; the power of flight extraordinary; the bill is short, hard, compressed, and arched above; hind-toe short.

The Collared Pratincole is the Perdrix de Mer of Brisson; das Rothfüssige Sandhuhn of Bechstein; Südliche Sandhuhn of Brehm; and Pernice di Mare of Savi. Though a few instances are on record of this bird having been killed within the British Isles, it can scarcely be admitted within the catalogue of our Fauna. It is a native of the eastern provinces of Europe on the Asiatic borders, and especially of Hungary, where extensive tracts of morass, and lakes, both fresh and saline, surrounded by low flat lands traversed by numerous rivers, afford food and security. In Western Tartary it is equally abundant. M. Temminck informs us that it breeds in Sardinia, and is numerous in Dalmatia, on the borders of the Lake Boecagnaro, on its spring passage; and that in Hungary, among the immense morasses of the lakes Neusidel and Balaton, he has been in the midst of hundreds sweeping through the air in chace of their insect prey, and darting along with arrow-like rapidity. Nor is it less remarkable for celerity on the ground, and often catches insects as it runs along. This graceful bird incubates amidst reeds, oziers, and the tall herbage of morasses. The eggs are four in number, of a yellowish white. In Germany, France, and Italy it is a bird of periodical occurrence. Two species, the G. grallaria and the G. lactea, are peculiar to the eastern provinces of Asia and certain parts of Africa. None are American. The general colour of the collared pratincole is brownish grey above; the throat is white with a tinge of reddish, banded by a narrow crescentic line of black; the upper tail-coverts are white; the under surface dirty white; the tail is forked, and brownish black; the under wing-coverts are chestnut. Length nine inches and a half. Naked circle round the eye red.

1847.—THE BLACK-BELLIED SWIFT-FOOT

(*Cursorius Temminckii*). In the genus Cursorius the bill is moderately long, arched, and compressed, with the nostrils basal, oval, and with an oblong lateral opening; wings pointed; legs long; toes three, all anterior—the middle toe the longest, with a serrated claw. The birds of this genus are natives of Africa, inhabiting inland tracts at a great distance from the sea, and running along the ground with extraordinary rapidity. One species, the Cream-coloured Swift-foot (Curs. Isabellinus) has been a few times seen in our island, and once in France, and once in Austria.

The black-bellied swift-foot is a native of Abyssinia. Its general plumage is creamy brown: the top of the head and the breast ferruginous; a double nuchal collar, the upper white, the lower black; sides of body white; the quills and centre of the under surface black. Length eight inches.

Family SCOLOPACIDÆ (CURLEWS, SNIPES, SANDPIPERS).

The members of this family are all inhabitants of marshy lands, the borders of swamps, lakes, and rivers, and the shores of the sea. Their food consists of worms, slugs, aquatic mollusks, &c.; for this purpose their bill is at once a probe, a feeler, and an organ of prehension. Most of the genera, observes Mr. Selby, procure food by thrusting the bill into the soft earth or the mud of the shore, whence they extract their prey. To facilitate this operation an extraordinary development of nerve is distributed over the bill, but more especially concentrated at the tip, which is thus endowed with an exquisite sense of feeling, and the membrane of that part is often pulpy. In many species the bill is further provided with a peculiar muscle which operates so as to expand the pulpy points of the mandibles, enabling the bird, with the bill still buried in the ground, to seize its prey the moment it is felt. From this peculiar mode of searching for their prey, many species, as the snipe, woodcock, &c., have been called birds of suction. The distribution of the Scolopacidæ is very general, their powers of flight are considerable, and they are all more or less migratory in their habits. They incubate on the ground; the eggs are four in number, of a peculiar form, being small and pointed at one end, large and obtuse at the other, and they are usually placed in the nest in a circle with the acute ends meeting in the centre, so as to occupy as small a space as possible. The flesh of many is in high estimation.

Fig. 1848, a Group of Scolopacidæ, representing—*a*, the Curlew; *b*, the Godwit; *c*, the Purre or Stint.

1849.—THE CURLEW

(*Numenius arquatus*). In the genus Numenius the bill is long, slender, curved, compressed, hard and subobtuse at the point: the upper mandible exceeding the lower, rounded towards the end, and channelled for three-fourths of its length; nostrils lateral, linear, and pierced in the channel; legs slender; hind-toe small, touching the ground; anterior toes united by a membrane as high as the first joint; wings moderate.

The curlew is the Courlis of the French; Chiarlotto and Chiurle maggiore of the Italians; der Grosse Krumschräblichte Schnepfe and Keilhaeke of the Germans; the Waup, Scotticè; Gylfinhr of the Welsh. The curlew is spread over every part of the Old World, from the torrid zone to the polar regions. It is found in India, China, Japan, and South Africa.

In its habits the curlew is migratory, and during the winter collects in large flocks, which frequent the low oozy shores of the sea, easily perforated by their bills, which they plunge into the mud in search of food. It wades in the shallows, and, when out of its depth, swims with considerable facility. Few birds are more shy and wary than the curlew, and while on the wing it utters a clear whistle as the flock wheels round in wide circles through the air.

In the high northern regions are the favourite breeding-haunts of the curlew, whither immense flocks repair early in the spring, but numbers continue in our island, leaving the low shores and southern districts for the wild and heathy parts of the interior, the wilds of Northumberland and the bleak Highlands of Scotland. The nest consists of withered grass or rushes placed in a depression under the covert of heath or other herbage. The eggs, four in number, are of a pale olive-green, blotched with two tints of brown. The young, which are at first covered with a yellowish white down varied with dark spots and markings, are assiduously attended by their parents, who manifest great courage in their defence, sweeping round the head of the intruder, uttering a loud cry of *courlis, courlis*, in quick repetition. In about six weeks the young are able to take wing. Three species of Numenius are natives exclusively of America.

1850.—THE WHIMBREL

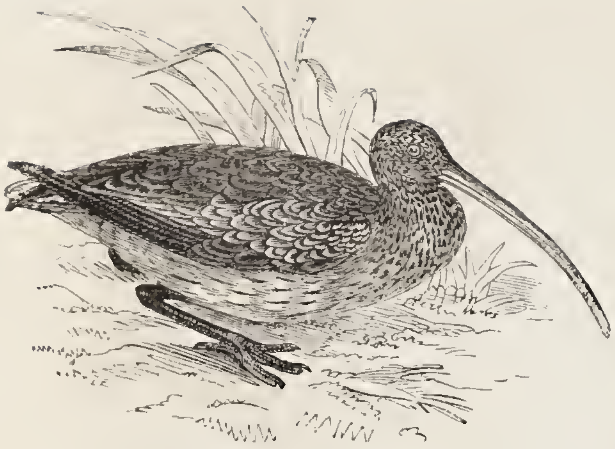
(*Numenius Phæopus*). Le petit Courlis or Courlieu of the French; Chiurlo piccolo, Chiurlo minore, and Mengotto of the Italians; Regen Brachvogel and Kleiner Goisser of the Germans; Coeg ylfinhir of the Welsh.

Though the whimbrel visits our coasts and those of the adjacent continent in winter, in small flocks, it retires to the higher northern latitudes in the spring to breed, Zetland being the only locality within the British Islands where it has been known to incubate. The range of this species is as extensive, or nearly so, as that of the curlew, which species it closely resembles in its habits, manners, and style of colouring, but is a much smaller bird, measuring only sixteen inches in length, of which the bill is three and a half; while the curlew exceeds two feet with the bill, which often measures six inches. Its flesh, like that of the curlew, is esteemed as well flavoured. An allied species, Numenius tenuirostris, is a native of southern Europe. The colouring both of the curlew and whimbrel is too well known to need a detailed description.

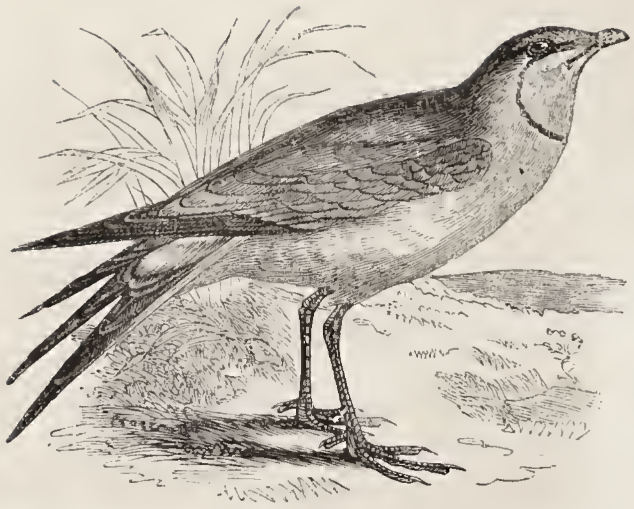
1851.—THE BLACK-TAILED GODWIT

(*Limosa melanura*). Beak and Foot. In the genus Limosa the bill is very long, more or less curved upwards, soft and flexible, depressed at the apex, which is dilated and obtuse; upper mandible furrowed; legs long and slender; hind-toe small; outer and inner toes united by a basal web; wings moderate.

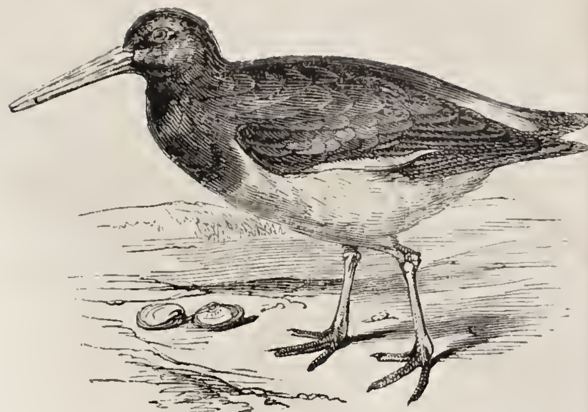
This species is the Grande Barge rousse of Buffon;



1849.—Curlew.



1846.—Collared Pratincole.



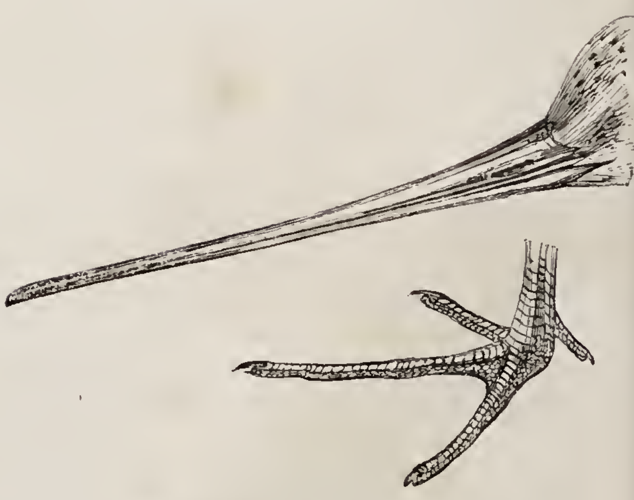
1845.—Oyster-catcher.

1848.—Group of Scolopacidæ.

1847.—Black-bellied Swift-foot.

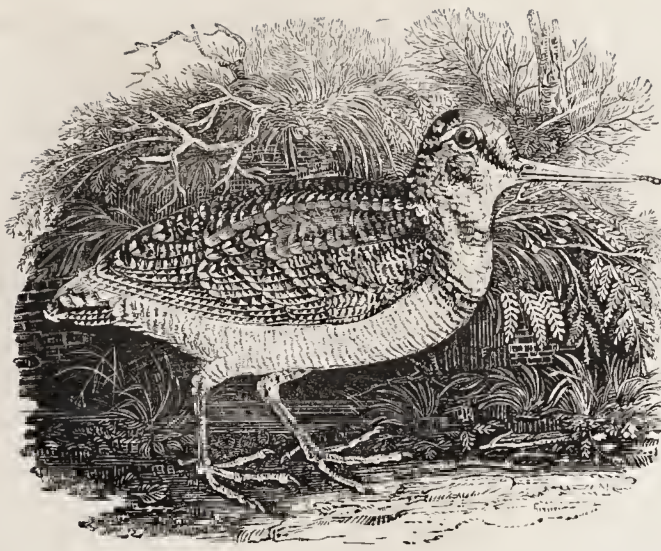
1852.—Hed and Leg of Snipe.

1850.—Whimbrel.



1851.—Beak and Foot of Black-tailed Godwit.

1853.—Solitary or Great Snipe.



1856.—Woodcock.

1861.—Ruff.

1854.—Jack Snipe.

1858.—Ruff and Reeves.

1859.—Ruff, in Summer Plumage.

1855.—Woodcock.

1857.—African painted Snipe.

1860.—Ruff, in Winter Plumage.

the Red Godwit of Latham; Dunkelfussiger Wasserlaufer of Meyer; Rostog of the ancient Welsh.

The godwit (with other allied species) undergoes a double moult, which nearly changes the entire colour of the plumage, and has led to some confusion; the young of the year differ from the adults. In its winter plumage this bird is the Limosa melanura of Lesler, and the Jadreka Snipe of Latham. In its spring plumage it is the Scolopax Belgica and S. ægocephala of Gmelin. The young of the year is the Totanus rufus of Bechstein. The female exceeds the male in size, but her colours are less bright.

The black-tailed godwit breeds in the high northern latitudes, but occasionally within the limits of the British Islands; during the winter it is spread along the shores of the whole of Europe, and specimens have been received both from India and Africa. In England the present species is not very abundant at any period, though it breeds sparingly in some of our fens. During the winter it frequents oozy shores and the embouchures of rivers, and plunges its long sensitive bill into the mud in search of food, viz., marine insects and worms, &c. The nest is formed of dry grass and herbage, and the four eggs are of a light olive brown, dashed with a darker tint. Its flesh was formerly in high esteem. Winter plumage:—upper parts uniform brown ash, the shaft of each feather being of a darker tint; rump blackish; front of neck, the breast, and sides, bright grey; under parts and base of tail-feathers, and also of the quill-feathers, pure white; a broad belt of black across the tail-feathers of which the central are slightly tipped with white; bill orange-yellow at the base, black at the tip.

Spring Plumage:—Feathers of the top of the head black, bordered with bright red; throat and neck red, transversely striped with fine zigzag markings; upper part of the back and scapulars deep black, terminated with a band of red and bordered by spots of that colour; wing-coverts ash; lower part of the back and tail black; under parts and base of quill-feathers white. Length fifteen inches. In the young the plumage of the upper parts is brown and blackish brown, greatly varied with red.

1848, *b*.—The Common or Red Godwit

(*Limosa rufa*, Brisson) is closely allied to the preceding, which it resembles in habits and manners, and extent of range, but may be distinguished by shorter legs, by the absence of white on the basal part of the quill-feathers, and by the tail-feathers being always distinctly barred. It is not known to breed in our island: its summer haunts are Iceland, Lapland, Sweden, and other northern countries. Both species fly very rapidly, and utter a singular cry while on the wing. The Prince of Canino notices two species, distinct from either of the preceding, as peculiar to America.

1852.—The Snipe

(*Scolopax Gallinago*). In the genus Scolopax the beak is long, straight, compressed, and slender, but swollen, minutely dimpled, and pulpy at the tip; the upper mandible is furrowed through half its length; the nostrils are lateral, basal, and longitudinal in the commencement of the furrow. Legs slender, of moderate length; wings pointed; eyes large, and placed back in the head.

The common snipe is the Bécasseau bécassine and Chévre voland of the French; Beccacino and Pizzarda of the Italians; Wald-schneppe of the Germans; Ysnittan y Finiar of the Welsh.

The common snipe is widely spread over Europe and the adjacent parts of Asia, being everywhere a bird of migratory habits; though it must be observed that it breeds in our island wherever favourable localities afford it shelter. It was found in considerable numbers in the Orkneys, by the late Sir H. Davy (1817), in the month of August; he observed that each nest contained two young birds, sometimes three, and describes the parents as exceedingly attached to their offspring, adding that if any one approach their nest they make a loud and drumming noise over the head of the intruder, as if to divert his attention. The snipe has been known to breed also in Dorsetshire, in the New Forest, in Cambridgeshire, in Norfolk, in Scotland, Wales, and Ireland. The nest is made of dry grass or herbage rudely put together, and placed in some depression under the covert of heath, fern, or long rushes near water, in swampy spots, or on marshy hills. The eggs are comparatively large, of a greenish white, spotted at the larger end with different tints of brown.

In winter our homebred birds are joined by vast accessions from Norway and other northern parts of Europe, the greatest number arriving in the beginning of November. These are ever on the move from place to place, frequenting swamps, the margins of rivulets, and oozy meadows along streams and rivers, in quest of food; this consists of worms, insects, &c., in order to obtain which they thrust their bill up to its base in the mud, and are guided by its exquisite sensibility.

About the beginning of April the snipe calls to his mate, uttering a piping or clicking note, often repeated, and accompanied at intervals by a humming noise, "apparently produced by the action of the wings, as the bird, whenever this sound is emitted, is observed to descend with great velocity, and with a trembling motion of the pinions. At this season it soars to an immense height, remaining long upon the wing; and its notes may frequently be heard when the bird itself is far beyond the reach of sight. These flights are performed at intervals during the day, but more commonly towards the evening, and are continued during the whole time that the female is engaged in incubation."

Of the ordinary flight of this bird, of its excellence for the table, and of the colours of its plumage, nothing need be said. The Prince of Canino parallels the Gallinago Wilsoni (Scolopax Gallinago, Wilson) of America with our European common snipe, to which it is very closely allied.

1853.—The Solitary or Great Snipe

(*Scolopax major*). Grande ou double Bécassine of the French; Beccaeino maggiore of the Italians; Mittelschnepfe of the Germans; Ysnid of the Welsh.

This species, also called the Double Snipe, is a rare visitor to our shores, during its autumn passage to the south, and also during its spring return to the northern regions, where it breeds. It is found in Norway, Sweden, and Germany, and visits the south of Europe, and the borders of Asia: it occurs in the neighbourhood of the Caucasus. Unlike the common snipe, it is a bird of heavy and steady flight, and often becomes so fat in the autumn, as Mr. Lloyd experienced near Gothenburg, as to be scarcely capable of taking wing. Its flesh is delicious.

This species is mostly found singly, occasionally in pairs; but in some districts is very abundant, affording excellent sport to the "chasseur." Sir H. Davy observed these birds breeding in the great marsh preserve near Hanover, and noticed that the larvæ of the Tipulæ (called Harry Longlegs) constituted the principal portion of their food. They breed also in Norway and Sweden, as high as the range of birch-woods extends. The nest resembles that of the common snipe. During the pairing season they fly to a vast height, and produce a drumming noise as they descend by the vibration of their wings. According to Mr. Greiff, the male has his playing-ground (or lek), where he observed the birds running about, and uttering a singular sound resembling a smack of the tongue, followed by four or five smacks of a louder tone: this habit would lead us to suppose that the great snipe is polygamous, like the ruff (Machetes pugnax).

In the great or solitary snipe the tail is composed of sixteen feathers; middle of the first quill whitish: top of the head black, divided by a band of yellowish white; stripe above the eye yellowish white; upper parts variegated with black and bright rusty, the latter colours being disposed longitudinally; under parts whitish rusty: abdomen and sides striped with black bands; bill inclining to reddish, brown at the point; feet greenish ash. Length twelve inches. Females larger than the males. Weight from seven to nine ounces.

1854.—The Jack Snipe

(*Scolopax Gallinula*). La Petite Bécassine and Bécassine sourde of the French; Moorschneppe of the Germans; Judcock, provincial English.

This species appears to be confined to Europe and Northern Asia, and is a periodical winter visitant to our island, making its first appearance about the second week of September. Early in March it quits our latitudes for the polar regions, where it breeds; we believe that there is no authenticated instance of its having been known to incubate in any of our fens. The jack-snipe frequents oozy bogs and marshes; when flushed, it utters no alarm-cry, and after a short direct flight drops in some miry spot, and is not to be easily roused again. This species is the smallest of the genus, being about half the size of the common snipe, and seldom exceeding two ounces and a quarter in weight: but its flesh is exquisite. It is generally found solitary; and, unlike the common snipe, having fixed upon one locality as its haunt, it seldom quits it for another, even though harassed by the sportsman. It sits very close, and will allow itself almost to be trodden upon before taking wing. The plumage of this bird is too well known to require a detailed description.

1855, 1856.—The Woodcock

(*Scolopax Rusticola*). Bécasse of the French; Beccaccia of the Italians; Waldschnepfe of the Germans; Cyffylog of the Welsh.

Though the woodcock is a native of the northern latitudes of Europe and Asia, its migratory range is very extensive, extending to Italy, Madeira, Barbary, Greece, Aleppo, and Egypt. It has been noticed in Cashmere and Japan. It breeds in Russia, Finland, Norway, Sweden, Siberia, &c., and also in Switzerland and Great Britain. With respect to its breeding in our islands, we might cite numerous authentic instances on record, but the fact is too well established to require such labour. We may however refer to Montagu, Bewick, Selby, and Yarrell, and also to Loudon's 'Mag. Nat. Hist.' 1837, pages 121, 337, 439. What, however, seems very extraordinary is, that woodcocks have been known, when apprehensive of immediate danger, to carry off in their claws both the young and their eggs. (See a paper by Mr. Fairholm in the Magazine referred to, p. 339, and also a paper by a correspondent, p. 122.) It is stated in the latter that the Blue Harrier (Circus cyaneus) also removes the eggs, when the nest has been molested.

The first flights of woodcocks from the north to our island generally occur towards the end of September or the beginning of October; but these flocks, after remaining a short time, wing their way to the more southern regions of Europe, and northern Africa, a few stragglers only remaining behind, which are afterwards joined by other arrivals during the latter part of October, November, and December. They generally come over in hazy weather with little wind, and that blowing from the north-east. Their favourite haunts are woods, moist thickets, close brakes, glens, and similar places, where they remain concealed during the day, but as soon as darkness sets in they leave these retreats, and scatter themselves over moist meadows and swampy open grounds, where they search for food, namely, slugs, insects, and especially worms, thrusting their bill into the earth, and drawing forth the captives. The digestion of this bird is very rapid. Mr. Selby states that he had known one to consume within a single night more large earth-worms than half filled a garden-pot of considerable size. The nest of the woodcock is a loose structure of grass and leaves, in a depression among herbage and thickets, near the root of a tree or bush. The eggs are usually four in number, of a pale yellowish white, blotched and spotted at the larger end with ash grey, and two shades of yellowish brown. During the pairing season the birds often pursue each other on the approach of dusk, circling the wood for an hour or two, and uttering a sharp but not very loud whistling note; besides this the male often flies low on heavy and flapping wings, keeping up an incessant croaking, or rather purring noise, not unlike that of the spinning-wheel. As the season advances, these circling flights and noises are discontinued, "the low croaking and occasional whistle being," as a writer observes, "peculiar to the period of incubation, like that singular noise made by the snipe in spring, as it rapidly descends in the air during its circuitous flight over its native morass."

We need not say that the woodcock is highly celebrated for the exquisite flavour of its flesh. When, however, the spring change of plumage commences, it loses its delicacy, and becomes rank and worthless.

The return of the woodcock to the regions of the north from our latitudes takes place in March, and by the middle of April all, save those that remain stationary with us, have disappeared.

The female somewhat exceeds the male in size.

1857.—The African Painted Snipe

(*Rhynchæa Capensis*). From the genus Scolopax are separated the painted snipes of Africa and India, which form the genus Rhynchæa; they are characterized by the beak being slightly arched at the tip. Their habits and manners are those of the snipes generally.

1858, 1859, 1860, 1861.—The Ruff

(*Machetes pugnax*). Female, the Reeve. Le Combattant and Paon de Mer of the French; Salsarola and Uccello muto of the Italians; Streisschnepfe and Rampfhählein of the Germans; yr Ymladdgar of the Welsh.

The genus Machetes was separated from Tringa by Cuvier for the reception of this remarkable species, celebrated for its combativeness and polygamous habits, no less than the singular changes of plumage which the male undergoes at certain seasons of the year. The ruff is generally distributed over Europe and the adjacent parts of Asia, and is a summer, not winter, visitant to our island, arriving in April, breeding in our fens, and departing in autumn. An occasional straggler remains with us during the winter. In Holland it is very abundant. In England the fens of Lincolnshire and Cambridgeshire are its principal resort. It would appear that the males are the first to arrive at their destined station; at all events they keep themselves in distinct bands, separate from the females. As the breeding-time draws near, beautiful long plumes round the neck, forming a ruff, and large full ear-tufts, rapidly develop. The males now begin to hill, as it is termed—that is, they seek some spot a

little elevated above the surrounding marsh, to which, as to a common centre, numbers are gradually drawn. Each individual selects its own station or little territory, for the possession of which it strenuously contends; the attempt of a rival to encroach upon the circle is immediately followed by a hard-fought battle, the territory being ceded by the vanquished to the victor. These battles and contests are almost incessant, at least during the day; for at night they all return to the marsh in order to feed (in this respect their habits being nocturnal), but in the morning each resumes its station, and the contests are again carried on. Here, full of animosity against each other, and jealous of each other's rights, they await the arrival of the females. The arrival on the hill of one of the other sex is the signal for a general contest. The scene is now one of perpetual warfare, female after female arriving at the hill, so that "the theatre of these battles," as Selby observes, "soon becomes bare of grass from the constant traversing of the combatants." Not only have the neck and ear plumes now attained their perfection, but the face of the male becomes covered with small yellowish papillæ, or fleshy excrescences, instead of the short feathers with which it is ordinarily clothed. During the whole of May and the early part of June this scene of warfare continues with unabated energy. The manner in which the ruff fights has much resemblance to that of the game cock; the head is lowered, the plumes are thrown up into a disc, the tail is expanded, and each adversary attempts to seize the other with his bill, following up his advantage by a blow with the wing. The contest is seldom fatal, the vanquished being rather wearied out and dispirited by the superior strength and determination of his antagonist, than seriously injured. Towards the latter part of June this combativeness abates, the papillæ on the face disappear, and shortly afterwards the fine plumes are moulted off, their place being supplied by ordinary feathers. (Fig. 1860.)

The females, or Reeves, which, as we have intimated, only visit the hill at intervals, breed among the swamps. The nest consists of little more than a slight depression amidst a tuft of grass, rushes, or other herbage. The eggs are four in number, and closely resemble those of the snipe, but are somewhat larger. In the group of Grallatorial birds, to which the present species belongs, the females usually exceed the males in size; here, however, the females are much smaller than the males, and moreover undergo no corresponding changes of plumage. With respect to the beautiful plumes which for a season ornament the ruff, one circumstance is very remarkable—namely, the diversity of their colouring: in no two examples is the colour precisely alike. We have seen them pure white; white elegantly barred with black; reddish brown intermixed with black, or barred and spotted; pure glossy black; grey and black, &c. It appears, moreover, that in no individual are these colours the same for any two seasons.

The ruff is among the list of birds whose flesh is accounted as a delicacy for the table; and considerable profit is made by various fowlers in the fens of Lincolnshire, who devote themselves at certain seasons of the year to the business of catching them and feeding them for sale. The means employed for taking them are chiefly clap-nets, into which they are lured by various devices, one of which is a stuffed bird of their own species. The seasons for taking them are, first, April and May, when the males are hilling, and pugnacious in the extreme; and secondly, September, after the young are fully fledged and ready for the autumnal migration, when they, with the old birds, pass to more southern latitudes. Their natural food consists of worms, small insects, &c., with which the soft ooze or mud of the marsh abounds; but they are easily reconciled to a change of diet, and feed eagerly upon bread and milk, boiled wheat, and other articles of a farinaceous quality, upon which they thrive and become plump. Captivity, which subdues the spirit of most wild creatures, does not abate the pugnacity of the full-plumed males taken in the spring. Not only will the appearance of a reeve excite them to strife, but a bowl of food set before them will produce the same effect, and lead to a tumultuous conflict, which, as the arena is very limited, and the weaker have no chance of escape, is sometimes known to result in fatal consequences.

Of the variable colour of the neck and ear plumes we have already spoken. The rest of the colouring may be thus described:—The upper parts of the body are varied with a mixture of brown, pale yellow, and black; the sides of the chest and flanks are barred with black on a pale yellow ground; the under surface is white. In some individuals these tints are much darker than in others.

The reeve in summer has the upper surface varied with glossy black on a cinereous grey ground; in winter the colour becomes more uniform, losing the markings of black.

1862.—THE KNOT

(*Tringa canutus*). Tringa cinerea, Temm.; Calidris Islandica, Stephens; Becasseau Canut, Temm.; Aberdeen Sandpiper, Pennant; Red Sandpiper, Latham.

The birds belonging to the genus Tringa (including Calidris and Pelidna) form a numerous assemblage, chiefly tenanting saline marshes and the shore of the sea, though some frequent the margin of lakes and rivers at a distance from the borders of the ocean. They associate in flocks, and perform periodical migrations in large bodies. They undergo a double annual moult, the summer livery differing remarkably from that of the winter; and the young, previous to the first moult, have a very different plumage from that of the adults. The food consists of worms, crustacea, and small mollusks, obtained on the shores of the ocean during the recession of the tide, and as the bill is not so highly sensitive nor so well adapted for plunging deep into the mud as in the snipes, they chiefly pick up their prey on the surface.

The Knot (Maubèche grise of the French; Chiurlo of the Italians; Aschgraus Strandlaufer of the Germans; y Cnut of the ancient British) is a rare bird in Germany, France, and the south of Europe; it breeds in the high northern latitudes of Europe and America, viz., Iceland, Greenland, North Georgian Islands, Melville Peninsula, Hudson's Bay, and the higher districts of Sweden and Norway. In autumn it visits Holland and the British Islands in great numbers, frequenting the shores of the sea, bays, inlets, and the mouths of rivers, where oozy grounds and muddy flats present an abundance of the minute bivalve shell-fish which constitute its principal food. The evolutions of the flocks on the wing are very interesting and beautiful. The flesh of this bird is in high estimation. About the close of April the flocks desert our shores for their arctic breeding-places. The Knot lays four eggs on a tuft of grass or herbage, without forming any nest; their colour is light yellowish brown, spotted at the larger end with grey and reddish.

In summer the plumage of the knot is rufous, or orange-brown varied with black, and with white edgings to the wing-coverts: in winter it is changed to a brownish grey, the wing-coverts margined with white; the under parts pure white, with brown lines on the breast, and transverse bars on the flanks, rump, and upper tail-coverts, which are white. Length ten inches. The upper figure represents the knot in summer plumage; the lower, in winter plumage.

1863.—THE LITTLE SANDPIPER

(*Tringa minuta*). Minute Dunlin, Stephens; Little Stint, Bewick; Pigmy Sandpiper, Richardson; Bécasseau Echasses, Temminck; Gambeccio of the Italians; der Hochbeinige Strandlaufer of the Germans; y Pibidd Ileiaf of the Welsh.

The Stint, or Little Sandpiper, is, with the exception of the Tringa Temminckii, the smallest of the genus. It visits our shores in autumn, frequenting mudbanks and saline marshes, and is often seen in the great morasses of Holland; it is common on the shores of the Lake of Geneva; it is found in India, North Africa, South Western Asia, and the south of Europe, and must also be included among the birds of North America. Dr. Richardson saw numbers in autumn feeding during the recess of the tide on the extensive flats at the mouth of Nelson's and Haye's rivers; and a specimen from Hudson's Bay is now in the British Museum. Where this species retires to breed is not ascertained; probably the north-eastern parts of Europe, Northern Asia, and the high latitudes of North America offer it a summer abode. The transitions it undergoes in the colouring of its plumage are similar to those of the Knot.

The upper figure is a bird in summer plumage; the lower figure to the left, the same in winter plumage; the lower figure to the right, the young of the year.

1864.—THE DUNLIN, OR PURRE

(*Tringa variabilis*). Tringa Alpina, Fleming; Pelidna variabilis, Stephens; Pelidna Cinclus, Cuvier; Tringa cinclus (winter plumage), Linn.; L'Alouette de mer à Collier, Cuv.; Bécasseau Brunette ou variable, Temminck; L'Alouette de Mer, Buffon; Tringa ruficollis, Pallas.

The Dunlin is widely spread, being common over Europe, a great part of Asia, and North America. It is indigenous in Scotland, where it breeds upon the shingle at the mouths of rivers, among salt marshes near the coast, and in the bogs of the upland country. Its nest resembles that of the snipe. The eggs, four in number, are of a greenish grey spotted with brown. In autumn, vast flocks from the high northern regions visit the shores of our island, where, as they sweep along, they perform singular evolutions, every individual, as if by some signal of command, simultaneously showing now the upper, now the under surface, which glance alternately, producing a singular and pleasing effect. Sandy bays and oozy shores are their favourite resort; and they run with great celerity and with a sprightly carriage, often uttering a soft piping note while busily engaged in search of food; when in motion, they are in the constant habit of moving the tail up and down. Marine insects, worms, crustacea, and minute shell-fish constitute their diet. On the wing they utter a weak scream. Their flight is easy and rapid. Summer Plumage:—Upper parts black, each feather being deeply margined with clear reddish brown; lower part of back brownish black; wing-coverts brown margined with grey; crown of head black; chin white; cheeks, throat, and breast black, each feather deeply margined with white; under parts black; flanks streaked with black. In winter the general tone of the upper parts of the plumage is ashy grey with a tinge of brown; chin and throat white; breast grey, with the shaft of each feather brown; under parts white; wing-coverts brown margined with grey; the larger coverts tipped with white; two middle tail-feathers brown, the rest grey.

1865.—THE MARSH SANDPIPER

(*Totanus stagnatilis*). This species, which is closely allied to the Green Sandpiper, the Redshanks, &c., is a native of Northern Europe, where it frequents the borders of rivers, lakes, and marshes, whence in the autumn it migrates southwards, pursuing its course through the eastern provinces to the Mediterranean, but does not frequent the maritime coasts of the ocean. It is abundant in Asia, and specimens killed in winter plumage have been received, according to Temminck, from the isles of Timor, Sunda, and New Guinea. The beak is long, weak, and awl-shaped, and its legs are elongated and slender. In summer its upper plumage is brown, with irregular black dashes; the under parts white, with brown specks on the throat and breast; tail striped diagonally with brown bands. In winter the upper surface is of a nearly uniform ashy grey: the under parts white; legs olive-green. Length about nine inches.

1866.—THE WILLET

(*Catoptrophorus semipalmatus*, Bonap.). Totanus semipalmatus, Latham and Wilson.

This species, separated as the type of a distinct genus, in consequence of the partial webs uniting the three anterior toes, is a native of America, and is only of accidental occurrence in Europe. "It arrives from the south, on the shores of the Middle States, about the 20th of April, and from that time to the last of July its loud shrill reiterations of *pill-will-willet* resound almost incessantly along the marshes." Like the other sandpipers, it breeds on the ground among the salt marshes near the coast, arranging a rude nest of rushes and coarse grass. The eggs are four in number, of greenish or bluish tinge blotched with blackish brown. The young are covered with grey down, and run about as soon as excluded from the shell, under the anxious care of the parents, who defend them much in the manner of our common lapwing, flying round the head of the intruder, and uttering a continued cry. When wounded, these birds take to the water, without hesitation, and swim with considerable facility. Small shell-fish, aquatic insects, &c., which the muddy shores afford in abundance, constitute their food. Summer Plumage:—Upper parts dark olive-brown streaked and crossed with waving marks of black, and sprinkled with touches of dull yellowish white; wing-coverts light olive-ash, with whitish freckles; primaries white at the base, black for the rest of their length; tail-coverts white barred with olive; tail olive barred with black; breast cream-white mottled with olive; under parts white; legs pale lead colour. Length fifteen inches. In winter the plumage above is pale dun streaked with dark brown; the tail white. At this season the willet associates in large flocks, and, being accounted excellent for the table, affords sport to the gunner. The female is generally larger than the male. In October and November the flocks leave the coasts of the Middle States for a more southern climate.

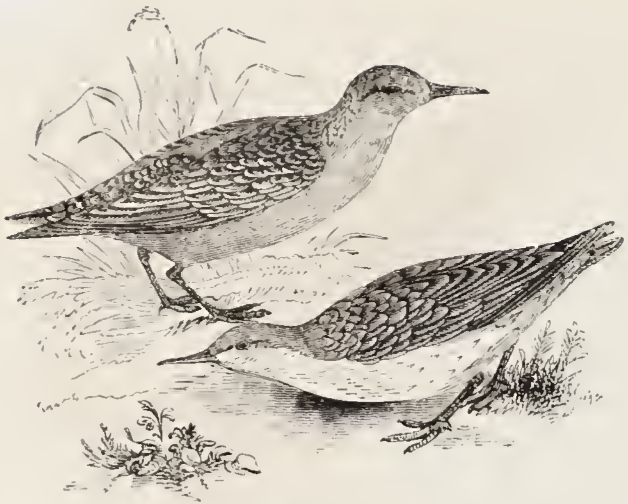
Family RECURVIROSTRIDÆ (AVOCETS).

The Prince of Canino divides the Avocets and Stilt-Plovers from the rest of the Waders, into a distinct family group.

1867, 1868.—THE BLACK-WINGED STILT-PLOVER

(*Himantopus melanopterus*). Charadrius himantopus, Linn.; H. rufipes, Bechst.; H. atropterus, Meyer; l'Echasse and l'Echasse à manteau noir of the French; Cavaliere grande Italiano of the Italians; Schwarzflügeliche Strandreuter of the Germans; Long-legged Plover and Long-shanks, English; Cwttyn hirgoes of the Welsh.

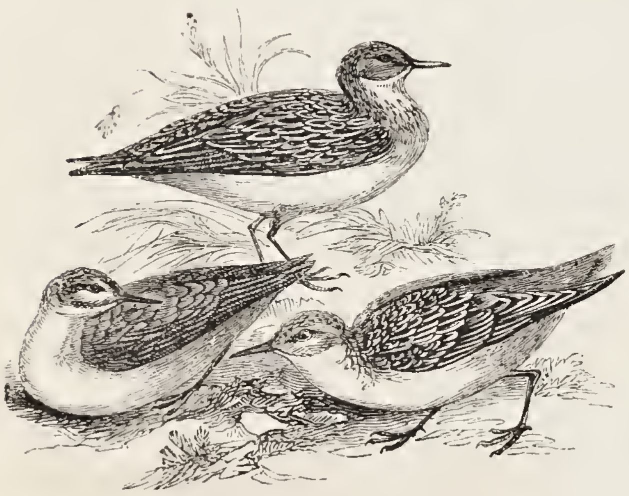
The members of the genus Himantopus are remarkable for the extreme length and slenderness of the legs; they are not numerous, but are distributed



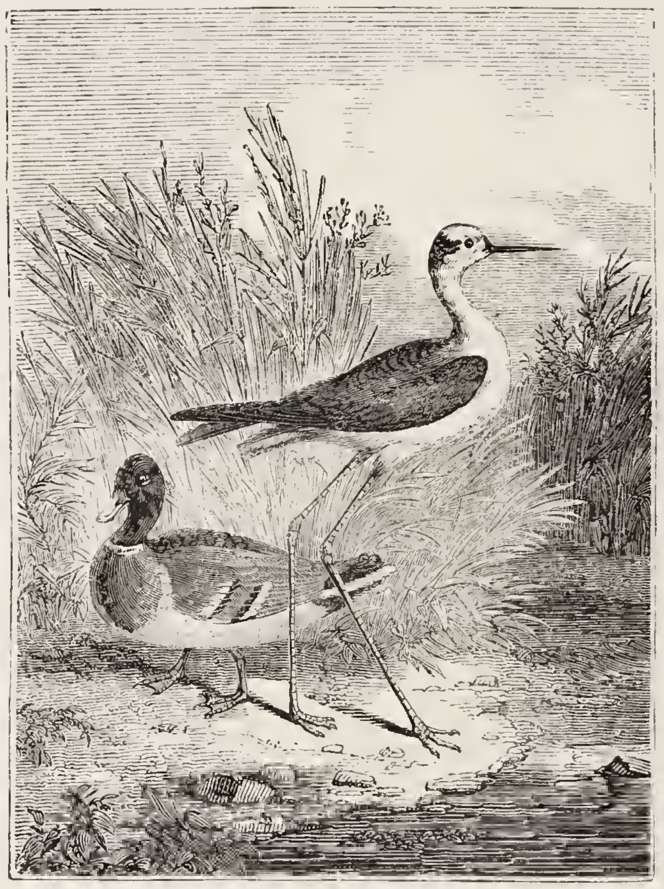
1862.—Knot.

1865.—Marsh Sandpiper.

1866.—Willet.

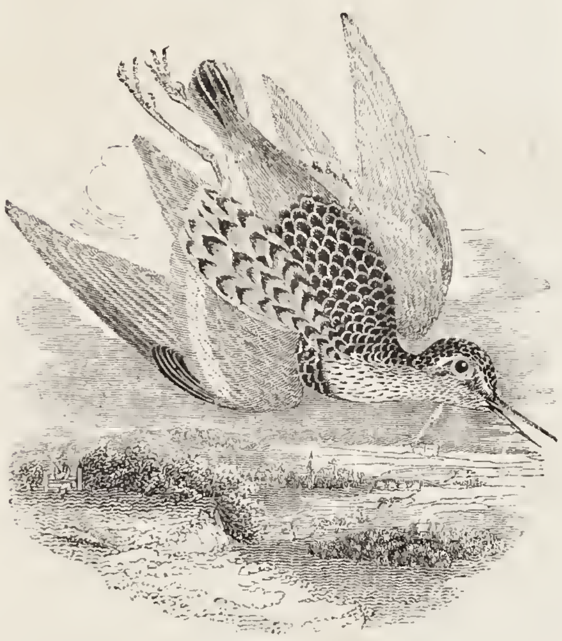


1863.—Little Sandpipers.



1867.—Black-winged Stilt-Plover.

1869.—Mexican Stilt-Plover.



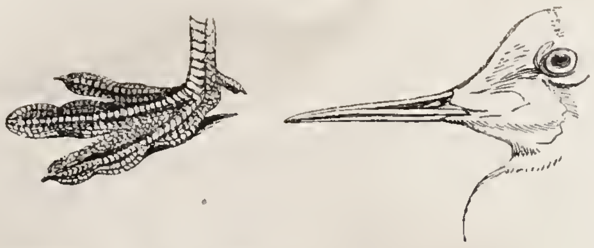
1864.—Dunlin.

1871.—Avocet.

1868.—Black-winged Stilt-Plover.

1870.—Palmated Stilt-Plover.

1874.—Grey Phalarope. Winter Plumage.



1872.—Bill and Foot of Red-necked Phalarope.

1873.—Grey Phalarope. Summer Plumage.

1878.—Water-Rail.

1880.—Spotted Crake.

1875.—Coot.

1877.—Hyacinthine Gallinule.

1876.—Moorhen.

1879.—Virginian Rail.

in every quarter of the globe. The present species only occasionally occurs within the British Islands, and is equally scarce and accidental in its visits in Holland and the northern parts of Europe. It is essentially a native of the eastern parts of Europe, whence it is spread throughout Asia to Japan, including India and the Indian Islands, and also from the north to the south of Africa. According to the Prince of Canino, the two species found in America are both distinct, and Mr. Gould has described the species found in Australia and Java as different, under the title of H. leucocephalus.

"The Long-legged Plover, as its conformation would lead us to conclude, is a bird whose most congenial habitat is morasses and the low flat shores of lakes, rivers, and seas. Hence in the eastern portions of Europe, where it is said to arrive from Asia in small flocks, it takes up its abode along the lakes and among the vast morasses of Hungary and Russia, where, according to M. Temminck, it rears its progeny, and where it fearlessly wades in search of its food, without much chance of its being carried out of its depth; but should such an occurrence happen, or the waves drift it out from the shore, it possesses, like many of the true Wading Birds, the power of swimming with great ease and lightness. Few birds exceed it in the powers of flight; its wings far exceed the tail, and it passes through the air with astonishing rapidity. When on firm ground, it appears as if tottering on long and awkward stilts, but firm ground is not its congenial habitat." (Gould, 'Birds of Europe.')

In the last part of his 'Manuel' M. Temminck states that this bird makes its nest upon a little eminence constructed in the marshes, laying four eggs of a tarnished green colour, marked with numerous ashy spots, and with moderate and very small reddish brown spots. In this species the cheeks, neck, and all the lower parts are white, with a roseate tinge; the occiput, back of the neck, and upper parts black glossed with green; the very old male has the occiput and back of the neck varied with white, sometimes quite white; bill black; iris crimson; legs vermilion. Length of head and body fourteen inches.

1869.—THE MEXICAN STILT-PLOVER

(*Himantopus Mexicanus*). This species arrives on the sea-coast of New Jersey in small flocks about the 25th of April; these subdivide into smaller parties, and settle together among the salt marshes, at some distance inland, where the sheet of water is broken into numerous shallow pools, through which they can wade in every direction, and which are not usually overflowed by the tides during summer. They feed upon minute shell-fish, insects, crustacea, &c. In the vicinity of these pools, six or eight pairs make their nests close together, forming them of grass, on which they deposit their eggs, but during the progress of incubation they add fresh materials, as twigs, seaweed, and the roots of grass, so as to elevate the platform previously constructed, which often weighs between two and three pounds. The eggs, four in number, are of a dark yellowish clay colour, thickly blotched with black. On the approach of an intruder, the males, who are roaming through the neighbouring marsh, rise in the air, flying with their long legs extended behind them, and keep up a perpetual yelping note of *click, click, click*, then alighting, they stand on half-bent trembling legs, with drooping quivering wings, uttering a purring sound, and seeming as if they balanced themselves with difficulty. This is done to draw off attention from the nests to themselves, and the avocet practises the same "ruse." Both also occasionally swim when they lose their depth in wading; and when wounded, they attempt to escape by diving, which, however, is not very expertly managed. They depart early in September, visiting Jamaica and the warmer parts of the American coast. In this species the bill is slightly curved upwards (not so much as that of the avocet) and tapers to a fine point; the outer toe is connected to the middle by a broad membrane, as also in the European species, which has the bill straight, slender, and channelled. Back of the head and neck, back, and wings, black glossed with green; the remainder of the plumage white; legs fine pale carmine; bill black.

1870.—THE PALMATED STILT-PLOVER

(*Cladorhynchus pectoralis*). The genus Cladorhynchus differs from Himantopus chiefly in the circumstance of all the fore-toes being connected together by partial webs. This species, which was discovered by Mr. Gould in Southern and Western Australia and Rottnest Island, resembles the common stilt-plover in its general habits. The body is white; the breast being crossed by a band of chestnut bordered anteriorly with black; wings and centre of abdomen black. In some specimens, presumed females, the pectoral band was greyish brown instead of chestnut, and in others the pectoral band was apparently disappearing; from which it is to be inferred that this mark exists only during the breeding season.

1871.—THE AVOCET

(*Recurvirostra Avocetta*). In the genus Recurvirostra the bill is long, slender, tapering, depressed, and bending upwards at the tip, which is very flexible; legs long and slender, and the three anterior toes united for nearly the whole of their length by a scolloped membrane.

The avocet is widely diffused through temperate Europe. It is found in Siberia, on the shores of the Caspian, about the salt lakes of Tartary, and also in Egypt, and other parts of Africa. In our island these birds are not uncommon along the eastern coast, south of the Humber, and breed in the fenny parts of Lincolnshire, and also in Romney Marsh in Kent. They are very rare in the north of England and Scotland. They abound in Holland. During the winter the avocet assembles in small flocks, frequenting muddy flat shores and the mouths of rivers, feeding upon marine insects, minute crustacea, and shell-fish, in quest of which it wades in the shallows, only swimming when unexpectedly out of its depth. Its slender, recurved, elastic beak, resembling whalebone, by no means organized as a feeler for plunging into the mud, enables it to scoop up from the surface of the slimy ooze the minute insects or worms on which it feeds: during this operation it appears as if it were incessantly beating the mud with its beak. Its actions are all quick and lively, and its flight is rapid and vigorous. During the summer the avocets are scattered in pairs over the fens and saline marshes, and select a dry spot on which to breed. The nest is merely a slight depression, sheltered by such herbage as the morass affords. The eggs are greenish, spotted with black. When disturbed during incubation, or while guarding their down-covered young, they fly round the intruder in circles, uttering without intermission their peculiar cry *twit-twit, twit-twit*, and, like the stilt-plover, will feign lameness, and crouch on trembling limbs, in order to decoy the object of their fear to a distance. The avocet is a beautiful bird; its general plumage is white, with the exception of the head, and back of the neck, the middle wing-coverts, and greater quill-feathers, which are black; bill black; legs bluish grey. The toes, which are webbed, give the bird superior advantage in traversing the soft oose in search of food. Length eighteen inches.

Family PHALAROPIDÆ (PHALAROPES).

The family Phalaropidæ is established by the Prince of Canino for the Phalaropes and their immediate allies, Lobipes and Holopodius—birds endowed with great powers of swimming, and often seen upon the surface of the ocean, even amidst the roughest waves. The plumage is thick and closely set, and the toes, besides being united together at the base by a web, are bordered by a continuation of the membrane, so as to make the feet efficient paddles. Their moult is double; their habitat the arctic and temperate latitudes. They fly with strength and swiftness.

1872, 1873, 1874.—THE GREY PHALAROPE

(*Phalaropus platyrhynchus*). Ph. lobatus, Flem. and Latham; Ph. griseus, Stephens; Phalaropus rufescens, Briss.; Red Phalarope, Latham; Plain Phalarope, 'Arctic Zoology;' Grey Phalarope, Selby; Ph. fulicarius, Bonap., Wilson.

The bill in the genus Phalaropus is rather long, weak, and slender; flattened, and wide at the base, furrowed to the point. The tarsi are slender, and compressed laterally. The three anterior toes are united up to the first joint, and bordered with festooned membranes dentelated on the edges. Hind-toes without a membrane. Wings moderate. Fig. 1872 represents the Bill and Foot of Phalaropus hyperboreus (Lobipes hyperboreus, Cuv.).

The grey phalarope is a native of the regions European, Asiatic, and American, within the Arctic circle, whence in autumn it migrates southwards, visiting temperate Europe, the British Islands, the great lakes of Asia, the Caspian Sea. Its food consists of aquatic insects, and especially those which live on the surface of the water, saline or fresh, in quest of which it swims with great address, and may be watched while engaged in this occupation displaying a thousand graceful attitudes and manœuvres. It not only frequents the shore, and the bays, creeks, and inlets of our island during the winter, but also mill-dams, large pools, and even farm-yard ponds, readily allowing itself to be approached, unsuspicious of danger. On the land the phalarope is less active and alert than the sandpipers (Tringæ), with which it was associated by Linnæus. Major Sabine, in his memoir on the 'Birds of Greenland,' states, that a number of these phalaropes were seen on the 10th of June, in the 68th degree of latitude (where the species breeds), at a distance of four thousand miles from land, swimming about in the midst of icebergs; and, referring to this account, M. Temminck observes that he cannot see why this bird, with such habits, and such a form as it presents, should be associated with the snipes and sandpipers (Chevaliers). The eggs of this species are greenish ash, spotted and dotted with black.

Summer Plumage (Fig. 1873):—Head, nape, back, scapulars, and upper coverts of the tail blackish brown; all the feathers of these parts are surrounded by a wide red-orange border: a yellowish band passes above the eyes; wing-coverts blackish, terminated with white; a transverse white band on the wing; rump white, spotted with black; front of the neck, breast, belly, abdomen, and lower tail-coverts brick-red.

Winter Plumage (Fig. 1874):—Top of the head, occiput, and nape pure ash-colour; a large spot of ashy black on the orifice of the ears; two bands of the same colour take their origin towards the eyes, and pass upon the occiput, where they form a single band, which descends the whole length of the nape; lateral parts of the breast, back, scapulars, and rump very pure bluish ash; blackish occupies the centre of all these feathers, and is directed along the shafts; the longest of the scapulars terminated with white; a transversal white band on the wing; tail-feathers brown, bordered with ash-colour; front, sides of the neck, middle of the breast, and all the other lower parts pure white; bill yellowish red at its base, brown towards the point; iris reddish yellow; feet greenish ash. Length above eight inches.

Family RALLIDÆ (RAILS and COOTS).

This family consists of several groups of birds, mostly of aquatic or semi-aquatic habits, from the diving and swimming coot to the terrestrial landrail, and exhibiting certain modifications of form according to the nature of the locality tenanted, viz. lake, morass, or meadow. In general the contour of the body is narrow and compressed. The Rallidæ have to thread their way through beds of the thick-set stems of reeds, bulrushes, and other aquatic plants, among which they seek shelter and concealment, or, as in the case of the landrail, through the tall grass of the meadow, and that so rapidly and noiselessly, that the field seems traversed by magic: hence they elude pursuit with great ease, and can seldom be forced to take wing. In all, the toes are long and spreading, giving them the facility of passing over soft ooze, or even the flat leaves of the water-lily, which float in close array on the surface of the water. The beak is generally strong, often remarkably so; but in this respect there is much variation.

1875.—THE COOT

(*Fulica atra*). Foulque, Macroule, or Morrelle of the French; Schwarzes Wasserhuhn of the Germans; Meir Koet of the Netherlanders; Folaga and Folacra of the Italians; Jâr ddwfr foel of the Welsh.

In the genus Fulica the bill is strong, straight, subconical, and compressed, and the base of the upper mandible is carried upon the forehead in the form of a broad expanded plate. The feet are large, and the toes are margined by lobated membranes. Plumage full and deep.

The coot is very generally spread over temperate Europe, and is particularly abundant in Holland. In our island it is common, frequenting large sheets of water, especially such as are surrounded with a broad belt of reeds and tall luxuriant aquatic plants, forming a dense covert for concealment. It swims and dives with the utmost address, nor is it inactive on land, and may be often seen early in the morning in humid low meadows adjacent to the water, wandering in search of slugs, worms, and insects, which, with aquatic larvæ, snails, and the fry of fishes, &c., constitute its food. When winter sets in severely and the inland waters are frozen, it journeys to the more southern districts of our island, visiting saline marshes, arms and inlets of the sea, and the mouths of rivers, as the Southampton water, where numbers congregate during the inclement season, and may be seen crowding the mud flats. The nest of the coot is a huge mass of grass, flags, and other herbage, sometimes situated among the reeds near the water's edge, at other times absolutely within the margin of the water, and rising above its surface to the height of eight or ten inches. The author of the 'British Oology' describes these nests as clumsy, but amazingly solid and compact. "So firm," he says, "are some of them, that whilst up to my knees in water they afforded me a seat sufficiently strong to support my weight." From the nature of the materials composing the nest, conjoined with its situation, it not unfrequently happens that it is torn from its moorings by floods and carried down the current; and instances have been known of such occurrences taking place, the female continuing to sit upon her eggs, which remained uninjured.

The eggs, from seven to ten in number, are of a

greenish white, thickly spotted with brown. The young are clothed with black down, tipped with grey, and immediately take to the water, under the protection of their parents till able to shift for themselves. The coot is not roused to take wing without difficulty, and then flies low and heavily, with the legs hanging down, or it just skims above the surface of the water, which it strikes with its feet by way of aiding its progress. It can, however, undertake a long-continued flight, as is evident from its semi-migratory habits, and Mr. Selby states that he has more than once seen this bird flying at a considerable elevation, with a very unexpected degree of strength and speed.

Dr. Von Siebold and M. Brüger saw the coot in Japan.

The description is as follows:—Bill pale rose-red; irides scarlet; frontal plate largest in the male, milk-white; head and neck deep greyish black; under parts greyish black, with a slight bluish tinge; upper parts slaty black; naked part of the tibiæ orange; tarsi greenish grey tinged with yellow.

1876.—THE MOORHEN

(*Gallinula chloropus*). Poule d'eau of the French; Gallinella of the Italians; Wasserhuhn and Braune Meerhuhn of the Germans; Dwfriar of the Welsh; Common Gallinule and Water-hen, English.

In Gallinula the beak is short and straight, the cutting edges of the upper mandible falling over those of the lower; a naked frontal plate; toes long and simple.

The moorhen, or water-hen, is dispersed over the greater part of Europe, Asia, Africa, Japan, and the Indian Archipelago, if indeed the species be identical, which is a question not settled. The Prince of Canino considers the two American species (G. galeata and G. Martinica) to be both distinct (as he does also the American coot, Fulica Americana) from their European representatives.

In our island the water-hen is abundant where secluded sheets of water, ponds, meres, or pools, bordered by beds of reeds and rushes, overhung by old willows and other trees, afford it an asylum. Though its feet are not fringed, it swims very gracefully, and dives with singular address, both in order to escape danger and to obtain food. In the former case it often remains immersed; amidst the shelter of the herbage, with little more than its beak above the water, watching till the danger is past. On the land it runs with great rapidity, and when suddenly surprised on the bank—where, as we have often seen, it delights to bask in flocks of ten or twenty—it dashes half running, half flying, into the water, and either dives, or skims half flying over the surface to the covert of the reed-bed, and instantly disappears.

While walking on the grass, it has a habit of flirting up its short tail, so as to display the white under-coverts; and in all its actions is smart, quick, and animated.

According to Mr. Gould, the female is clothed in a dark rich plumage, and has the base of the bill and the frontal plate of a bright crimson red, tipped with fine yellow; while the male, contrary to the general rule, has the upper surface more olive than the female, and the bill also is less richly tinted. The female, though more richly clad, is one fifth less than her mate. The food of this species, in addition to aquatic larvæ, worms, &c., consists of aquatic weeds, and grain, as wheat and barley. The waterhen selects a retired spot in which to breed, and conceals the nest amidst the sedges, reeds, and flags of the waterside; sometimes it is placed upon a low, thickly-foliaged, floating branch, or the stump of an old pollard: it is formed of matted flags and rushes. The eggs are of a yellowish white, marbled with tints of brown, and vary from five to nine in number. On leaving her nest, the female always covers up her eggs, principally with a view to their concealment from the rat or the snake. The young are at first covered with black hairy down, and immediately take to the water. In five or six weeks they are fully fledged, and able to provide for themselves. Numbers, however, fall a prey to the rat, the weasel, the hawk, and the pike. Base of the bill and frontal plate red; head, throat, neck, and under parts blackish grey; ridge of the wing and under tail-coverts white; upper parts of the body dark olive green; legs dusky green, with a garter of red above the tarsal joint.

1877.—THE HYACINTHINE GALLINULE

(*Porphyrio hyacinthinus*). Poule Sultane of the French; Pollo Sultano, Savi; Gallo-fagiano of the Catanians.

The genus Porphyrio is characterized by having the bill very strong, thick, compressed, and almost as high as long; the frontal plate extending from the base of the beak is very considerable; the tarsi are strong, the toes of great length, without any developed membranous edging.

These birds, observes M. Temminck, live nearly like the water-hens, to which they are the most closely approximated; like them, their habitual haunts are the fresh waters; but the immense rice-fields (rizières) and marshes of the south equally serve them for an asylum and retreat. More inclined by their appetite to cereal grains and plants than to aquatic herbs, the porphyrios frequent the land more than do the water-hens: they swim with grace, and run with elegance and swiftness on the land or over the plants which grow in the water. Their body is not so compressed nor so slender as that of the water-hens; their formidable bill, composed of a very hard substance, and nearly without a nasal fossa, which is covered by a membrane, serves them as an instrument for cracking the husks of grains and breaking the hardest stems; their feet, which they use to seize their food and convey it to their bill, are provided with very long toes, easily retractile, and with nails which bend also with some facility, giving them the power of prehension. A brilliant plumage, where blue or a turquoise hue predominates, clothes the greatest number of the known species.

The hyacinthine gallinule is rather widely spread, though it is not a native of northern or western Europe, but of the southern and eastern provinces, the marshes of which are its places of constant resort. "Its range is extended," says Mr. Gould, "over a great portion of Africa to the south, and as far as the mountains of the Himalaya to the east. In Europe it is especially abundant in the Grecian Archipelago, the Levant and the Ionian Islands: it is less common in Dalmatia and Sardinia. The southern provinces of Hungary and Russia and the borders of the Caspian Sea may also be enumerated among its European localities." M. Temminck states that it is to be seen in many cities of Sicily (where, according to M. Cantraine, it is very common in the neighbourhood of Lentini); that it is not known in Dalmatia nor Calabria, and is rare in Sardinia; and that it is known in Catania under the name of Gallo-fagiano.

Beautiful as this bird is, and active and graceful as are its movements, it is by no means intelligent; indeed it may be said to be stupid, since, as we are assured, when hard pressed it buries its head in the mud as if for safety. It breeds in the marshes, much in the manner of the common water-hen, giving preference to the sedgy parts of the morass and partially inundated rice-fields, where it constructs a nest of aquatic shrubs, and lays three or four white and nearly round eggs. It is probably this species which was held in such high esteem by the Romans, and kept in temples and palaces for the sake of its beauty. Pliny notices its habit of soaking its food in water and then raising it to its beak by means of its claws: "pede veluti manu."

Bill fine red; legs and feet fleshy red; irides lake red; cheeks, throat, sides of the neck, and chest turquoise blue; the remainder of the plumage deep indigo blue, with the edges of the greater and lesser wing-coverts more brilliant; under tail-coverts white. Length eighteen inches.

1878.—THE WATER-RAIL

(*Rallus aquaticus*). Rale d'eau of the French; Merla d'acqua of the Italians; Wasser Ralle of the Germans; Cwtair of the Welsh.

In the genus Rallus the bill is lengthened and slender, and very slightly arched. The water-rail is distributed over Europe, and some parts of Asia, having been seen by Dr. Von Siebold in Japan. In our island it is not uncommon, but is very shy and recluse, tenanting secluded marshes and ponds, where the thickest reed-beds screen it from observation, through which, from the compressed form of its body, it glides with the utmost facility and address: it thus easily eludes the pursuit of the dog, winding about till it gains some deep hole or other recess, and can therefore seldom be flushed. It also swims and dives with remarkable ease, and if pushed hard instantly disappears, rising at a distance and pressing forward to the reed-bed.

While moving undisturbed in search of food, the water-rail, like the moorhen, has a habit of flirting up its short tail so as to show the cream-white under-coverts. In the winter, this bird, if it does not positively migrate, resorts to the sides of large streams and rivers, where various insects, worms, &c. are always to be procured. The nest of this species is made of coarse grasses, and concealed amidst the thickest herbage in the most inaccessible part of its haunt. The eggs are from six to eight in number, of a yellowish white colour marked with spots of brown. When first excluded, the young are covered with black down, and follow their parents, swimming with equal address.

Bill brown at the tip, orange-red at the base; throat pearl grey; sides of the neck, the breast, and under surface bluish or slate grey; flanks greyish black barred with white and cream yellow; under tail-coverts cream white: the whole of the upper surface yellowish brown, the centre of each feather being velvet black. Legs brown flesh-colour; iris orange. Length twelve inches.

1879.—THE VIRGINIAN RAIL

(*Rallus Virginianus*). The Prince of Canino enumerates three species of water-rail as natives of North America, of which he parallels the Virginian water-rail with our British species.

This species, says Wilson, is frequently seen along the borders of salt-marshes, and breeds there, as well as among the meadows bordering the larger rivers; it spreads over the interior of the country as far west as the Ohio, and is common in the Barrens of Kentucky early in May. In its habits it is migratory, never wintering in the Northern or Middle states, which it leaves on the setting in of the frost; but many linger in the low wooded marshes of the Southern states throughout the winter. With respect to its general manners the Virginian rail closely agrees with our water-rail, winding through the dense reed or cane beds, and swimming and diving with the same address.

The nest is composed of grass and rushes; the eggs are from six to ten in number, of a pale cream colour, spotted with reddish and pale purple. Its food consists of worms, the larvæ of insects, and small shelled snails. In colour this species much resembles the European water-rail, but is smaller, and has none of the slate or lead colour on the breast which marks the latter, and its toes are comparatively shorter. Length ten inches.

1880.—THE SPOTTED CRAKE

(*Crex Porzana*). The genus Crex, as characterized by Selby, has the bill shorter than the head, subcultrated and compressed, with a lateral furrow on each side of the upper mandible, and in which the nostrils are pierced. Wings armed with a spine. The recent fashion for making genera has led to the division of this group, which contains four European species, into the following generic divisions: Porzana of Vieillot; Zapornia, Leach, Alecthelia, Swainson, being synonyms; and Ortygometra of Ray, of which the common corn-crake is the sole European representative.

The crakes are birds of shy and recluse habits, living concealed in the thick herbage of the meadows or marshes; they have a thin compressed form of body; run with a skulking gait and great rapidity, seldom taking to wing unless when suddenly surprised. Their flight is laboured. Insects, worms, vegetables, and seeds constitute their diet.

The spotted crake, Poule d'eau Maronette of the French, is one of our earliest birds of passage, arriving in March and departing in October. On the continent of Europe it is widely spread, everywhere haunting the margins of pools and rivulets overgrown with reeds, sedges, and thick herbage. It extends its range to Western Asia and Africa.

The nest of this species is built amongst the sedges and reeds of the pool or marsh, and the foundation is frequently under water; it is composed of a large mass of aquatic plants interlaced, with a hollow at the top, neatly formed and comfortably lined. The eggs are eight or ten in number, of a yellowish grey tinged with pink, and spotted with dark and pale brown. Worms, aquatic insects, grain, and various seeds constitute the food of the spotted crake, and in autumn it becomes loaded with fat, and is accounted excellent for the table.

Bill lemon-yellow, red at the base; forehead, eye-streak, and throat deep smoke-grey; crown of the head brown, the feathers edged with yellowish brown, and speckled with white; breast and under parts olive-green, tinged with grey, with transverse dashes of white surrounded by a streak of black; upper parts black, the feathers being deeply edged with olive-green, and marbled with markings of white surrounded by a list of black; under tail-coverts olive-green; legs wax-yellow.

1881.—THE CORN-CRAKE

(*Crex pratensis*). Rale de Genet, ou Roi des Cailles of the French; Re di Quaglie of the Italians; Weissen Knarrer of the Germans; Regen yr yd of the Welsh; Landrail, Corn-drake, Daker-hen, English.

The Corn-crake is spread over the whole continent of Europe, and is very abundant in Holland. It visits the southern districts of our island in April, but seldom appears in the north before the beginning of May. In some localities it greatly abounds; in others it is little known. In the rich meadow-lands of Cheshire the monotonous cry of this bird, like *crake-crake-crake*, may be heard during May and June resounding on every side; now close at hand, as if the bird were not a yard distant; now far off; while the voices of others in different parts are unremittingly exerted. This note, which is the call of the male to his mate, and which ceases on the commencement of incubation, may be imitated by drawing the finger or a stick across the teeth of a comb. So shy and cunning is the bird, that it is

1881.—Corn-Crake.

1885.—Head of Horned Screamer.

1882.—African Jacana.

1886.—Crested Screamer and Young.

1888.—Cariama.

1884.—Horne Screamer.

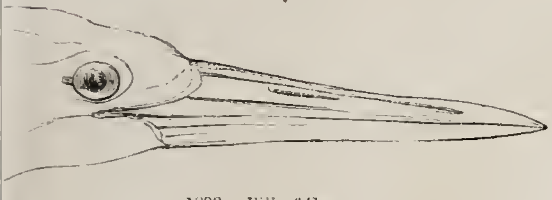
1883.—Com mon Jacana.

1887.—Crested Screamer.

1892.—Crane.

1890.—Crane.

1889.—Golden-breasted Trumpeter.



1893.—Bill of Crane.

1897.—Crowned Crane.

1894.—Demoiselle.

1891.—Crane.

1898.—Bill of Heron.

895.—Demoiselle.

1900.—Pectinated Claw of Night-Heron.

1899.—Head of Heron.

1896.—Stanley Crane.

seldom to be seen; and unless by means of a dog accustomed to such work, it is almost impracticable to force it to take wing; it seems to elude pursuit as if by magic, and is here and there, threading its way through the long grass, before its pursuer can imagine it has even left the spot from which its call had first resounded. Its swiftness and dexterity are indeed almost incredible. The corn-crake breeds on the ground, making a nest of dried grass in some depression, the female laying from eight to twelve eggs; they are of a yellowish white, covered with dull rust-coloured spots, and in size nearly equal to those of a partridge. The young, when first excluded, are covered with a blackish hairy down, and follow the parents; and in six weeks are able to fly. Worms, insects, vegetables, and seeds constitute the food of this bird; it is very fond of grasshoppers. Its southward migration takes place in October, when it passes over to the Continent, and continues its gradual progress. The flesh of the corn-crake is in high esteem as a delicacy. The description is as follows:—A large ash-coloured eyebrow, prolonged upon the sides of the head; all the feathers of the upper parts blackish brown in the middle, bordered laterally with ash-colour, and terminated with reddish; the long feathers which extend on the quills entirely bordered by a large band of olive-reddish; coverts of the wings of a rusty red; quills reddish externally; throat, belly, and abdomen white; breast olive-ash; sides reddish, striped with white; upper mandible brown, lower whitish; iris reddish brown; eyebrows flesh-colour; feet flesh-colour or reddish brown. Length nine inches and a half.

Family PALAMEDEIDÆ (JACANAS, SCREAMERS, &c.).

This family, established, we believe, by the Prince of Canino, comprehends the Jacanas, so remarkable for their long legs, toes, and spine-like claws, and the Screamers or Çariamas of South America; all birds inhabiting morasses and swampy grounds, which they traverse in quest of food.

1882.—The African Jacana

(*Parra Africana*). In the genus Parra the bill is moderate and compressed, and of a straight and slender figure; the legs and toes are long and straight, or, slightly recurved, of enormous length; wings armed with a spur. This genus is spread over South America, India and its islands, Australia and Africa, China, &c. In contour and habits the species are analogous to our moorhen, frequenting lakes, sheets of water, ponds and morasses, and where undisturbed are far from being shy. "The number of these birds (says Mr. Swainson) on the lakes of Brazil, the elegance of their movements, and their fearlessness of man, excite an interest in the traveller who journeys through regions ornamented alone by nature. They are very light birds, and their long toes spreading over a wide surface enable them to walk over the floating leaves of aquatic plants with as much facility as if they were on land. In such situations their appearance is really delusive, for their pressure being sufficient to sink the surrounding leaf just below the surface, the birds actually appear to walk upon the water."

The African Jacana is a native of Abyssinia, Mozambique, the Western Coast, and South Africa: it is of a deep cinnamon colour above; the crown of the head is naked; the throat is white; the breast fulvous; the neck and quills black. The spur on the wing is a mere rudiment.

1883.—The Common Jacana

(*Parra Jacana*). This species is spread over the hotter regions of South America, Brazil, Guiana, &c. Its general colour is black, with the back and wing-coverts rufous; the first quill-feathers are green; the spurs on the wing are large and sharp; at the base of the beak are singular appendages of leathery skin.

The Chinese Jacana, Parra sinensis, is a native of India, is characterized by a long and graceful tail, and the quill-feathers are terminated with slender appendages like little narrow plumes proceeding from the tip of each shaft. This is a most elegant bird, and is not uncommon in museums. It has been received from the Himalayan range.

1884.—The Horned Screamer

(*Palamedea cornuta*). Kamichi in Guiana; Anhima in Brazil; Camouche of the people of Cayenne.

In the genus Palamedea the bill is shorter than the head, convex, slightly vaulted, bent at the point, and covered at the base with small bristles; nostrils oval, open; wings spurred. Fig. 1885 represents the Head of the horned screamer, or kamichi. It is amidst the vast swamps and savannahs of Cayenne, Guiana, and Surinam, teeming with animated beings, that the horned screamer is to be found, and where its loud voice is to be heard at intervals above the incessant din of mingled cries, the croak of legions of frogs, and the hum of insect armies, which fill these districts with unceasing and discordant clamour. In size the horned screamer almost equals a turkey, and its voice is extraordinary and startling. According to Marcgrave it consists of the syllables *vyhou-vyhou*, uttered loud, clear, and shrill. Nor is it only for its voice that the screamer is remarkable, but also for the weapons of offence and defence with which it is armed. On the shoulder (as it is termed) of each wing are two large, sharp, and hard spurs, projecting directly forwards, and constituting formidable instruments. From the top of the head, in the present species, rises a slender pointed horn, three or four inches in length, and gently curved forwards. The use of this appendage to the head is not clear, but there can be no possibility of mistaking the use of the shoulder-spurs. Snakes of various size, all rapacious and all to be dreaded, abound in the haunts frequented by the screamer, and these formidable weapons enable the bird to defend itself and its young against the assaults of such enemies. If not attacked, the screamer offers molestation neither to reptiles nor to birds; its habits are shy, its manners gentle, and it lives in pairs united for life.

The kamichi wades in quest of the leaves and seeds of aquatic plants, on which it feeds, and for which its muscular gizzard is adapted, though some have asserted that reptiles constitute its food. The flight of the horned screamer, as might be expected from the length and expanse of its wings, is strong and sweeping; on the ground it walks with its head elevated, and with an air of pride, insomuch that many of the older writers regarded it as an aquatic kind of eagle. It is said to build its nest on the ground at the foot of a tree, and to lay two eggs, like those of the goose. The general colour of this species is glossy blackish brown, the under parts white. The head and upper part of the neck are covered with downy feathers of a blackish colour interspersed with white.

1886, 1887.—The Crested Screamer

(*Palamedea chavaria*). Parra Chavaria, Linn.; Chauna Chavaria, Illiger; the Chaïa or Chaja of Azara.

This species is a recluse bird haunting the banks of the rivers and swamps of Paraguay and Brazil. It lives singly or in pairs, but is sometimes seen in flocks. It does not swim, but wades in quest of aquatic plants, on which it feeds. Azara observes that he has seen Chajas brought up from the nest in various houses in the country, and that they were as domesticated as the poultry. They are very courageous, and will drive off a vulture. The same writer also informs us that the chaja perches on the loftiest trees; on the ground it walks with the body horizontal, the head and neck raised vertically, the beak being rather kept down. Its cry is loud and shrill, and uttered not only during the day, but the night also: that of the male is represented by the word *chaja;* that of the female, *chajali;* and they respond to each other's call. The wings are armed with double spurs; but, except in self-defence, it is gentle and quiet. The chaja flies well, and often wheels around in vast circles till out of sight.

August is the breeding-season of this species; the female lays two eggs, and the young, while yet covered with down, follow their parents in the same manner as do the young of the plover and lapwing. The nest is spacious, and is constructed of twigs and sticks, and placed, according to some, on bushes and low trees surrounded by water; or, according to others, among the reeds and tall herbage which grow in the midst of the morass.

As in the former species, the limbs are naked above the joint, and are covered with hexagonal scales; the middle toe is united to the outermost by a web extending as far as the first joint; the claws are long, sharp, and scooped out beneath. The head is small and crested; the eyes encircled by a naked skin, of a blood-red colour. The legs and toes are rose-pink; the claws black; head and upper part of the neck downy, the latter encircled with a black collar; general plumage lead-colour and blackish, with a spot of white at the bend of the wing, and another at the base of some of the greater quills. Length three inches.

We are not aware that living specimens of either species have been ever brought to our island, but we do not apprehend that there would be much difficulty in the accomplishment of their safe transportation. Fig. 1886 represents an Adult Chaja, accompanied by its young, just hatched, and still clad in down.

1888.—The Çariama

(*Dicholophus cristatus*, Ill.). Palamedea cristata, Gmelin; Saria of the Guaranis; Seriema of the native Brazilians.

It is perhaps between the Screamers and the Trumpeter (Psophia) and the Cranes that we must place this remarkable bird, which inhabits the vast solitary mountain plains surrounded by forests which extend over so large a portion of Brazil, and where its loud sonorous voice breaks the silence of the desert. It runs with astonishing swiftness, trusting to its speed, and not its wings, for safety. Shy, recluse, and wary, the çariama stalks along on the watch against surprise; its eye instantly marks the distant intruder, and it prepares for flight. Those who have had the best opportunities of observing these birds state that their capture is a work of great difficulty; they are hunted on horseback, and, like the ostrich, so rapid is their course, with many turns and windings, that it is not till after a sharp pursuit that the bird, wearied out, crouches or takes to a bush or tree; and till this happens, the horseman in vain seeks to use his rifle or lasso. The çariama is said to feed on reptiles, insects, and perhaps seeds. It flies badly, and rarely takes wing. Wild as this bird is in its natural condition, it is easily domesticated, and will live sociably with the other tenants of the poultry-yard. In this state they will eat little pieces of meat, but are said to refuse maize, though it is probable that other kinds of grain may not be disagreeable to them. When thus tamed, they will walk about the hamlet or village where they have been brought up, and even return after taking short trips in the fields, like the poultry. The flesh is described as very good food; it is, however, seldom eaten by the Brazilians.

Its nest is composed of dry sticks and branches, covered with cow-dung, and placed upon a low or a moderately high tree. The eggs are generally two in number, and white.

The çariama stands very high on the legs, and the hind-toe is seated high on the tarsus; the space round the eye is naked and bluish; the head is crested with light feathers, and long loosely-barbed feathers cover the neck; the upper eyelid is fringed with long lashes. The general colour above is pale umber brown, with fine zigzag markings of a darker tint; wing-feathers blackish, finely barred with white lines dotted with blackish; under parts whitish; bill coral red; legs orange; iris yellow. Length thirty-two inches. For an account of the anatomy of this bird see 'Proceeds. Zool. Soc.,' 1836, p. 27.

Family GRUIDÆ (CRANES).

In this family the bill is moderate, the legs are long, the wings rounded, with the secondaries elongated into drooping plumes; in most if not every species the trachea exhibits some peculiarity, and usually is much convoluted before entering the chest. Instead of deriving their sole subsistence from lakes and morasses, the members of this family live in a great measure on vegetable food, and frequent plains, newly-sown lands, and cultivated districts.

1889.—The Gold-breasted Trumpeter, or Agami

(*Psophia crepitans*). This beautiful bird, which equals a large fowl in bulk, with a much longer neck, and standing much higher on the limbs, is a native of the forests of tropical America, and the wild uplands, never visiting fens or the borders of lakes or rivers. It is gregarious, associating in considerable flocks, and walks and runs with great ease and celerity, but seldom takes wing, and then only rises a few feet above the surface of the ground. It trusts to its speed of limb for safety. In captivity its docility and attachment are remarkable. According to M. Monoucour, it "is not only tamed easily, but becomes attached to its benefactor with all the fondness and fidelity of the dog; and of this disposition it shows the most unequivocal proofs. When bred up in the house, it loads its master with caresses, and follows his motions; and if it conceives a dislike to persons on account of their forbidding figure, their offensive smell, or of injuries received, it will pursue them sometimes to a considerable distance, biting their legs, and testifying every mark of displeasure. It obeys the voice of its master, and even answers to the call of all those to whom it bears no grudge. It is fond of caresses, and offers its head and neck to be stroked; and, if once accustomed to these familiarities, it becomes troublesome, and will not be satisfied without continual fondling. It makes its appearance as often as its master sits down to table, and begins with driving out the dogs and cats, and taking possession of the room; for it is so obstinate and bold, that it never yields, and often, after a tough battle, can put a middle-sized dog to flight. It avoids the bites of its antagonist by rising in the air, and retaliates with violent blows with its bill and nails, aimed chiefly at the eyes; and after it gains the superiority, it pursues the victory with the utmost rancour, and, if not parted, will destroy the fugitive. By its intercourse with man, its instinct becomes moulded like that of the dog; and we are assured that it can be trained to tend a flock of sheep. It even shows a degree of jealousy of its rivals; for, when at table, it bites fiercely the naked legs of the negroes and other domestics who come near its master."

This remarkable bird has obtained the name of Trumpeter from a hollow internal sound which it makes without opening its bill, and which, according to Pallas, results from a peculiar construction of the windpipe, which at first is as thick as a swan's quill, but becomes more slender upon entering the chest, when it gives off two membranous semicircular sacs, or air-bags, of which that on the right is the most extensive, and divided into three or four cells. The hollow internal drumming, preceded by a wild cry, is evidently produced from the vibration of the air forced into these air-bags from the lungs, by the action of the muscles of the chest and back, and during the utterance of the sound the chest is seen to heave as in birds while singing. We are here reminded of the drumming of the emeu. The trumpeter is said to scratch a hollow in the ground at the root of a tree for the reception of the eggs, which are from ten to sixteen in number, and of a light green colour. The down remains long on the young.

The head, except a circle round the eyes, and the whole of the neck, are covered with black velvety feathers; on the breast they become large and are rounded, their edges being of a metallic glossy purple and green; the back is covered with long silky plumes of a delicate grey, which hang gracefully over the wings, which latter are black, as are also the tail and under surface; the feathers of the tail are soft and short; the feathers of the under parts are loose and hairy; bill black; tarsi pale yellowish olive.

1890, 1891, 1892.—THE COMMON CRANE

(*Grus cinerea*). Grue of the French; Grua of the Italians; Kranich of the Germans; Goran of the Welsh.

In the genus Grus the bill is long, straight, and compressed laterally, the upper mandible having a furrow on each side, in which are placed the nostrils; wings moderate, the secondaries nearest the body elongated into drooping plumes. Fig. 1893 represents the Bill of the common Crane. The trachea runs a convoluted course within an extensive cavity in the substance of the deep keel of the breast-bone, whence it emerges to enter the chest. The gizzard is strong and muscular.

The crane is spread over a great portion of Europe, Asia, and Africa, and from the earliest times has been noticed as a bird of migratory habits. Associated in large flocks, they journey northwards in spring to their accustomed breeding-places, and return southwards in autumn to India, Egypt, and other parts of Africa. According to Latham the crane visits Sweden, Russia, Siberia, and the whole of northern Asia. Dr. Von Siebold noticed it in Japan. Formerly it was a regular visitor to our island, where it bred before cultivation had deprived the species of congenial localities by the inclosing of waste tracts of land and the drainage of marshes. We hear of statutes imposing a fine upon those who should presume to take away the eggs of a crane or bustard. Willughby says, "Cranes come often to us in England, and in the fen counties of Lincolnshire and Cambridgeshire there are great flocks of them." It appears that no less than two hundred and four were served up at the feast of Archbishop Nevil in the reign of Edward the Fourth. At present the crane is very rarely seen within our shores, and almost as rarely in Holland.

The aërial voyages of the crane are performed at a high elevation in the air, and though the loud cries of the passing flock may reach the ear, the birds themselves are beyond the limits of our sight. These flights often take place during the night-time. The crane makes its nest among rushes, reeds, and the long herbage of swampy tracts, and sometimes on the walls of isolated ruins. The eggs are two in number, of a pale dull bluish green, blotched with brown.

Wide open lands newly sown are often visited by this bird, for the sake of the grain, to which it is very partial, but it also haunts morasses, feeding upon shelled mollusks, worms, frogs, and other reptiles. The general colour of the crane is dark grey, the top of the head being red and naked, on the back of the head and front of the neck the grey approaches black; many of the secondaries form long loose drooping plumes; bill greenish black; iris red brown; legs black. Length from the bill to the end of the tail three feet eight or ten inches.

1894, 1895.—THE DEMOISELLE

(*Anthropoïdes Virgo*). Ardea Virgo, Linnæus. The demoiselle, or Numidian crane, is remarkable for grace, symmetry of form, and elegance of deportment. It is widely spread in Africa, and, like the cranes in general, is migratory in its habits. It extends along the Mediterranean, and is abundant in the neighbourhood of Tripoli; it visits Egypt during the inundation; and appears about Constantinople in October, on its return from the southern coasts of the Black and Caspian seas. It has been observed at Lake Baikal, and has been killed in Nepâl; on the west of Africa it extends from Egypt to Guinea, and is found near the Cape of Good Hope. The food of this beautiful bird consists in a great measure of grain and seeds, to which it adds insects, worms, &c. It bears our climate well, and has bred in France; one of the young ones, reared in the menagerie of Versailles, lived there for twenty-four years.

The demoiselle stands about three feet six inches in height. The top of the head is grey; behind each eye springs a tuft of white feathers, passing backwards to the occiput, where they form a drooping crest of soft loose plumes, which undulate with every movement; the sides of the head, the neck, and a long flowing plume depending from the breast, blackish; general tint delicate slate grey; the secondary quill-feathers elongated into slender plumes, which fall over the quills and tail; bill yellowish.

1896.—THE STANLEY CRANE

(*Anthropoïdes Stanleyanus*). Anthropoïdes paradisæus, Bechstein.

In beauty, gracefulness, easy elegance of movement, this species equals the demoiselle, to which indeed it is closely allied. It runs and bounds with singular velocity, and sweeps along with expanded wings in chace of insects, which it takes as they flit by, and to which it is very partial. In captivity it is gentle and familiar. It is a native of India, perhaps also of Africa. The full soft feathers of the head make it appear as if tumid. The general plumage is bluish grey, passing into brownish black on the points of the tail-feathers and the long pendent flowing wing-plumes, which touch the ground. This species somewhat excels the demoiselle in stature, and the hind-toe is comparatively larger.

1897.—THE CROWNED CRANE

(*Balearica Pavonina*). This species, and one from South Africa, the Kaffir Crowned Crane (Balearica Regulorum), said to be held sacred by the Kaffirs, are the only two species at present known of the genus Balearica ('Proceedings of the Zoological Society,' 1833, p. 118), which is now separated from Anthropoides. Till recently these two species were confounded together by most naturalists.

The crowned crane is a native of Northern and Western Africa. The Romans are supposed to have received them from the Balearic Islands, now Majorca and Minorca. In Guinea and at Cape Verd, as well as in the adjacent countries, they are very common, frequenting swampy places, and subsisting, like the crane, partly on grains and other vegetables, partly on insects, mollusks, small fish, &c. At Cape Verd these birds are said to be so familiar as to come into poultry-yards, and feed in company with the domestic inmates. Their gait is slow and stately, but expanding their wings, and assisted by the wind, they scud along with great velocity. Their flight is lofty, and capable of being long sustained. Their voice is loud, trumpet-like, and hoarse.

In captivity the crowned crane becomes very tame and gentle; like the rest of the family to which it belongs, it generally reposes resting on one leg, with its neck bent, and its body maintained almost horizontally. It often, however, assumes a very different attitude, standing perpendicularly upright, with its long neck on the full stretch; in this position it remains for some short space of time gazing steadfastly at the spectator, and then breaking out into a hoarse kind of chuckle.

The crowned crane stands about four feet in height; the front of the head is covered with short black velvety feathers; from the occiput there rises a remarkable crest of slender bristle-like filaments, diverging from each other, with a spiral twist, and four or five inches in length. Their colour is yellowish; they are fringed with minute black barbs. The cheeks are naked, the upper portion of the denuded space being white, the more extensive space below red; there is a small wattle on the throat. The general plumage is bluish slate-colour; the feathers of the fore-part of the chest are elongated; the primary quills and the tail are black; the secondary quill-feathers, which are long and slender, are of a rich brown, and the wing-coverts pure white.

In the Kaffir crowned crane (B. Regulorum) the naked cheeks are white, with a roseate upper margin, and the throat-wattle is large. Both species, together with the two preceding, are living in the Gardens of the Zoological Society.

Family ARDEIDÆ (HERONS).

This family is very extensive, embracing not only the true Herons, Egrets, and Bitterns, but also the Storks and Boatbills, and therefore consists of several minor groups, varying in certain details, though agreeing in general characteristics. They frequent, as a rule, the margins of rivers, lakes, or marshes, feeding on fish, reptiles, and even small mammalia. Essentially formed for wading, the legs are very long, and the neck and bill proportionate. In most the beak is very sharp-pointed, often with the upper mandible sulcated as in the heron. The toes are generally elongated, the hind-toe is applied fairly to the ground, and the claw of the middle toe in the herons, egrets, and bitterns is pectinated. Though in general they build and breed in societies, they always wander alone in search of food, and after the breeding-season lead a solitary existence. Many are adorned with elegant plumes and crests. Their wings are ample; their flight buoyant. Figs. 1898 and 1899 represent the Bill and Head of the Common Heron. Fig. 1900, the Pectinated Claw of the Night-Heron.

1901, 1902.—THE COMMON HERON

(*Ardea cinerea*). Héron of the French; Beccapesce, Airone, and Garza of the Italians; Reyger and Rheier of the Germans; Cryr glâs of the Welsh; Hern, Heronshaw, Hernseugh, English; Hearonsewys (Herons), in Household-Book of the fifth Earl of Northumberland.

In the true Herons the beak is long, straight, compressed, and sharp, with a delicate cere at the base, and the upper mandible sulcated. Lores naked. Legs long, naked high above the tarsal joint. Wings ample and rounded; middle claw pectinated. See our account of the Goatsucker (p. 286, vol. i.), in which there is similar pectination. The common heron is spread over the greater part of the world, inhabiting Asia and Africa, as well as Europe. In America it is represented by an allied species, Ardea Herodias. In our island and in temperate climes the heron is stationary, but is migratory in colder latitudes. Except during the breeding season, this fine bird is solitary, haunting rivers, sheets of water, and preserves of fish, where it often commits considerable damage. Recluse and suspicious, the Heron sits roosting during a great part of the day on his accustomed branch in some remote and dense part of the wood; or, where marshes are extensive, he may be observed in the middle of the morass, standing on one leg, immoveable as a statue, and so stationed as to command a wide prospect around. If roused by an intruder from this spot of repose, he spreads his wings, mounts into the air, and sails away for some distant and more secluded retreat. To come upon him by surprise is very difficult. It is early in the morning, with the grey of the dawn, after sunset in the evening, and especially during moonlight, that the heron takes his prey, excepting, indeed, when the calls of his nestlings demand his continual exertions. He may then be seen in lonely and secluded nooks, standing in the water, with glistening eye, and head drawn back ready for the fatal stroke: patiently does he maintain his fixed attitude: presently a fish passes; sudden as lightning, and, with unerring precision, arrow-like he launches his beak, and up he soars bearing the captive to his nest. It is not generally known that the heron will swim. The following fact is related by P. Neill, Esq., of Canonmills, near Edinburgh. This gentleman had a pair of these beautiful birds tame, and, after some interesting particulars, he thus continues:—"A large old willow-tree had fallen down into the pond, and at the extremity, which is partly sunk in the sludge and continues to vegetate, waterhens breed. The old cock heron swims out to the nest, and takes the young if he can; he has to swim ten or twelve feet where the water is between two and three feet deep. His motion through the water is slow, but his carriage is stately; I have seen him fell a rat by one blow on the back of the head, when the rat was munching at his dish of fish." (Selby's 'Ornithology.') The heron, as we have said, builds, like the rook, in societies, choosing the highest trees for the purpose; and the breeding-places are termed heronries. In modern days these are much more limited in number than formerly, when the heron was protected for the pleasure of the knight and noble, who flew at it their best falcons, and regarded it as a choice delicacy in their banquets. Fig. 1903 is a Heronry, with the surrounding wild scenery, on the river Findhorn, Morayshire, and described in the 'Penny Magazine,' for June 6, 1840, p. 220.

About a mile from the town of Reading, in a low meadow traversed by a rapid brook flowing into the Kennet, is a heronry, which we have often visited, and near it a rookery, but neither the herons nor rooks seem to interfere with each other, or offer each other any injury or molestation. The nests are flat and built of sticks. It is amusing to see the herons sailing to and from their city, on wide-spread wings, and wheeling and hovering around their brooding-mates or young; while a loud clanking chatter, uttered by numbers without intermission, and heard at a considerable distance, resounds from the crowded nests, half hidden amidst the foliage of the tall trees, which for years they have colonized. The eggs of the heron are five in number, of a dull

1901.—Heron.

1902.—Heron.

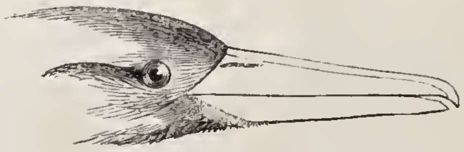
1906.—Night-Heron.

1903.—Heronry on the river Findhorn, Morayshire.

1904.—Bittern.

1908.—Tufted Umber.

1907.—Night-Herons.

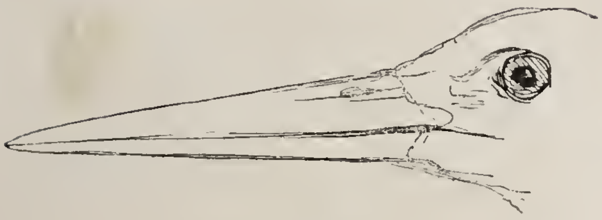


1909.—Bill of Tufted Umber.

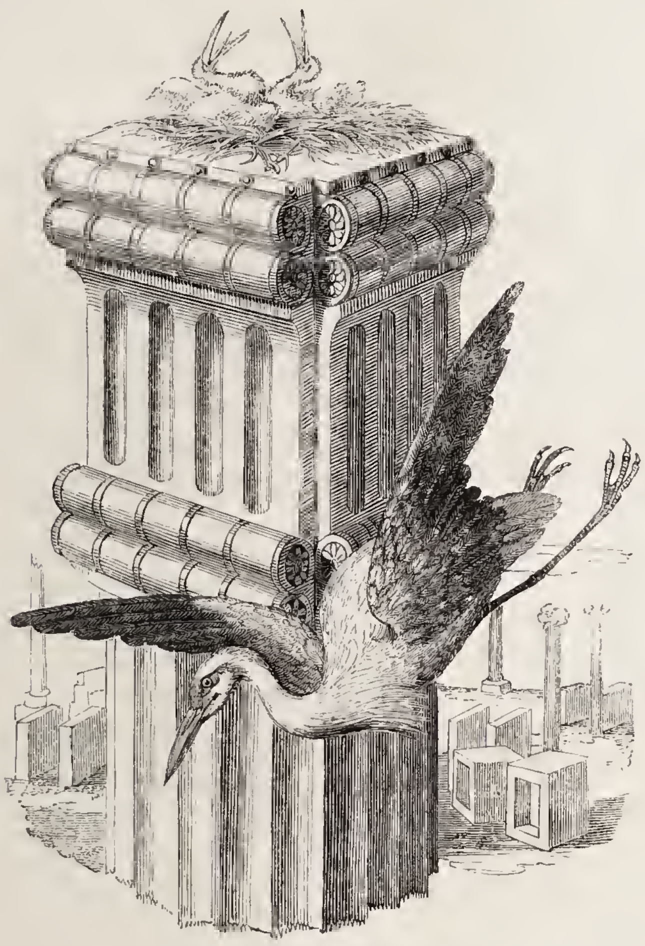
1905.—Bittern.

1911.—Stork.

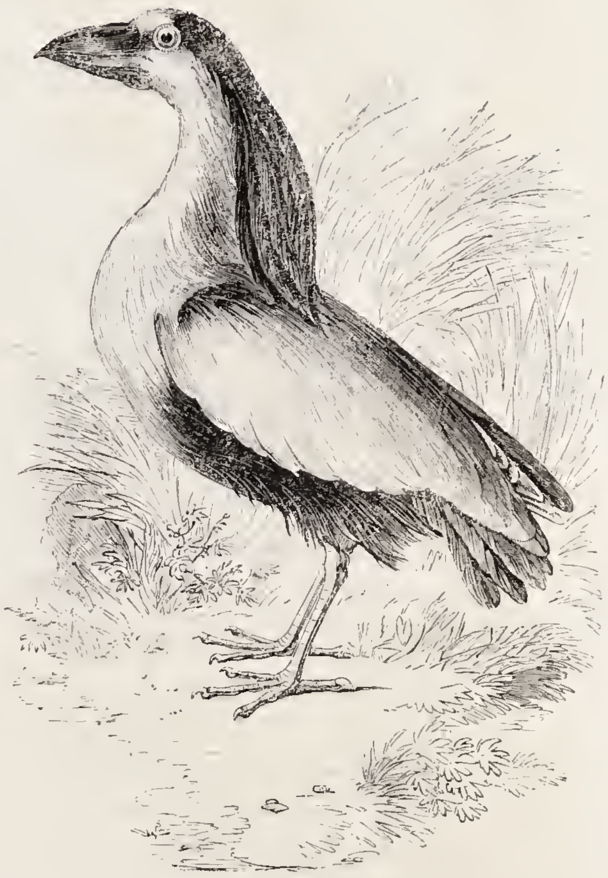
1912.—Stork.



1916.—Bill of Stork.



1917.—Stork's Nest at Persepolis.



1910.—Boatbill.

1915.—Stork.

1913.—Stork.

bluish green. The young remain five or six weeks in the nest, and the old birds unceasingly supply their voracious appetite with fish, and defend them with great resolution.

The colouring of the heron in full plumage, which is not attained till the third year, is as follows:—Long, loose, black feathers adorn the back of the head, and similar plumes of a lustrous white depend from the lower part of the neck; the equally elongated and subulate scapulars are of a silvery ash. Forehead, neck, middle of the belly, border of the wings, and thighs pure white; occiput, sides of the breast, and flanks deep black. On the front of the neck are large longitudinal black and ash spots. Back and wings very pure bluish-ash; bill deep yellow; iris yellow; naked skin of the eye bluish purple; feet brown, but of a lively red towards the feathered part. Length three feet and upwards.

1904, 1905.—The Bittern

(*Botaurus stellaris*). Butor of the French; Ueeello lepre and Trombutto of the Italians; Rohrdommel of the Germans.

The Bittern is found in Europe, Asia, and Africa, and was once common in England, when, in the palmy days of falconry, it afforded one of the "great flights," and was protected by severe penalties, but is now comparatively scarce, though a few are said still to breed in the fenny counties. Its flesh, rank as we should deem it, was accounted a great delicacy.

The bittern frequents wild morasses and the oozy banks of large rivers, where extensive tracts overgrown with flags, reeds, and bulrushes afford it an asylum. In the midst of these it crouches during the day, and is with difficulty roused to take wing, when it flies slowly away to a distant haunt, uttering from time to time a resounding cry, different from the "boom," which is peculiar to the breeding season, which has given rise to some of its provincial names, as Mire-drum and Bull-of-the-Bog: this noise has been erroneously supposed to be made by the bird while plunging his bill into the mud, and is first heard in February or March, while—

> "As yet the trembling year is unconfirm'd,
> And winter oft at eve resumes the breeze,
> Chills the pale morn, and bids his driving sleets
> Deform the day delightless—so that scarce
> The Bittern knows his time, with bill engulf'd
> To shake the sounding marsh; or from the shore
> The Plovers when to scatter o'er the heath
> And sing their wild notes to the listening waste."
>
> *Thomson.*

During the early part of spring the bittern "booms" from the midst of the marsh at intervals throughout the day, and then on the approach of dusk he soars spirally to a vast height, uttering his hollow boom, which sounds not unlike the deep-toned roar of a bull.

The nest of this bird is a rude structure, and placed not on trees, but by itself in the solitude of the morass, on some slight elevation. The eggs, five in number, are of a pale green. The bittern, when wounded, defends itself with great determination, throwing itself on its back like a bird of prey, and launching its formidable beak with great force against its enemy, generally aiming at the eye; consequently it is not to be approached without caution. In olden days, when the hawk had brought the bittern down, it was the falconer's first care to plunge the bill of the latter into the ground, lest the hawk should be impaled.

In size the bittern is rather less than the heron. The plumage is beautifully varied with spots, bars, and dashes of black on a fine reddish yellow ground. The feathers of the head and neck are long and loose, and capable of being thrown forward. Bill brown above, greenish below; iris yellow; legs pale green; middle claw pectinated. Frogs, field-mice, newts, and fish, with the buds of the water-lily and other aquatic plants, constitute the food of the bittern.

1906, 1907.—The Night-Heron

(*Nycticorax Europæus*). Ardea Nycticorax, Linn.; Bihoreau and Roupeau of the French; Scarza Nitticora of the Italians; der Nacht-Raiher of the Germans. In its young state, the Spotted and Gardenian Heron of Latham; Night-raven.

This species is very widely spread over Asia, Africa, and Southern Europe; but in America is represented by the Qua-bird (N. Americanus, Bonap.), till lately confounded with it. In our islands the night-heron is a bird of rare and accidental occurrence; it has been killed at Frogmore, near Windsor, and in other places: in Spain it is common, and in the adjacent countries. In many respects it resembles the common heron in its manners, breeding, like that bird, in society, on the topmost branches of trees, and roosting during the day in the recesses of woods adjacent to wild swamps and rivers, which it visits on the approach of twilight in quest of prey. During the flight of these birds to their fishing-stations, and throughout the night, they continually utter a hoarse hollow croak, ominous of death, in the ears of superstition, as we believe is also the boom of the bittern, at which dread roar the credulous wayfarer of the night has stood aghast with terror.

Wilson, speaking of the American species, or Qua-bird, which visits Philadelphia in great numbers, breeding in the tall trees of the vast cedar-swamps, says that "on entering the swamp the noise of the old and of the young would almost induce one to suppose that two or three hundred Indians were choking or throttling each other. The instant an intruder is discovered, the whole rise in the air in silence, and remove to the tops of the trees in another part of woods, while parties of from eight to ten make occasional circuits over the spot to see what is going on." While flying from their roost to the marshes, about the beginning of evening twilight, he says, they utter "in a hoarse and hollow tone the word *Qua*," whence the name Qua-bird.

In the night-heron the legs are not so long in proportion, nor is the space above the tarsal joint naked for so great an extent, as in the common heron. The middle and outer toe are connected at the base by a membrane, and the middle claw is pectinated.

The adult plumage is as follows:—Top of the head, back, and scapulars black with bluish and greenish reflexions; three white very narrow feathers, six or seven inches in length, taking their origin at the back of the head, just above the nape, and descending backwards; lower part of the back, wings, and tail clear ash-colour; forehead, space above the eyes, throat, front of the neck, and lower parts white; bill black, yellowish at the base of the lower mandible; iris red; feet yellowish green. Length rather more than one foot eight inches.

In the young of the year the three long feathers from the back of the head are wanting, and the general plumage is of a brown tinge, dashed and variegated with rufous; the lower parts being clouded with brown, white, and ash-colour.

1908.—The Tufted Umber

(*Scopus Umbretta*); Ombrette of the French. In this genus the bill deviates from that of the true herons, in having the point decidedly deflected, the tip of the upper mandible being abruptly hooked, and that of the lower truncated. (See Fig. 1909, the Bill of the Tufted Umber.) The nostrils are linear; the wings long; the tail short and square; the legs moderate. All the toes are united at the base by a membrane.

Of this form, but one species, the tufted umber, is known; a bird extensively spread throughout Africa, and characterized by a peculiarly soft and lax plumage, the back of the head in the male being furnished with a full puffy crest. The general colour of this bird is deep umber brown, whence its name; the crest being of a much paler tint. Size, that of a crow. Habits not recorded.

1910.—The Boatbill

(*Cancroma cochlearea*). Le Savacou of the French. Notwithstanding the strange form which the beak assumes in the present genus, the Boatbill is closely allied to the herons, and has in a great degree the same habits and manners; its beak, however, instead of being straight, compressed, and pointed, is of an oval form, much depressed, with a ridge along the top of the upper mandible, which somewhat resembles an inverted spoon, and to which the lower mandible, of nearly the same figure, is applied, rim in contact with rim. It is in fact the bill of a heron, shortened, and flattened out laterally. The nostrils are situated in a furrow along each side of the ridge. The toes are three before and one behind. Legs moderate.

The Boatbill is a native of Guiana, Brazil, and other parts of South America, and of recluse habits, frequenting rivers, wide swamps, and marshes, where it patiently watches, from its perch on some branch overhanging the water, the movements of the finny race, and precipitates itself, somewhat in the manner of the kingfisher, on such as approach the surface. It has been thought to live on crabs also, whence the name Cancroma, but this is by no means ascertained. Leach, indeed, in his 'Zoological Miscellany,' 1815, says that it feeds on fishes, worms, and crustacea, in quest of which it is continually traversing the borders of the sea. Lesson, in his 'Manuel,' 1828, says that the boatbill perches on trees by the side of rivers, where it feeds not on crabs, as its name indicates, but on fish; he speaks of it as inhabiting the flooded savannahs of South America, and as being especially common in Guiana. Some years since an individual of this species was living in Exeter 'Change; it had the lorn melancholy aspect of the herons, and was fed principally on fish. Of its mode of incubation and the minor details of its history, nothing appears to be known.

In the male, from the top of the head arises a long plume of jet-black narrow feathers, pointed, and falling down upon the back, producing a beautiful effect. The throat is bare; the forehead and neck, of which latter the feathers are elongated and form a sort of mane very characteristic of the herons, are greyish white. The back, also ornamented with long feathers, is of a fine grey, sometimes with a rusty tinge; the tail is white; the sides are black, the middle of the under surface deep reddish brown. Bill blackish; legs brown. Claw of middle toe pectinated. In the female the feathers of the top of the head are black, without being elongated into a pendent crest. In size this bird somewhat exceeds a common duck, but, with the exception of the beak, exhibits the general contour of the herons.

1911—1915.—The Stork

(*Ciconia alba*). In the genus Ciconia the bill is long, straight, robust, subconic, unfurrowed, and pointed, with the culmen, or upper ridge, subcultrated. The nostrils are linear, and pierced in the horny substance of the upper mandible near the base. The legs are long, and naked high above the tarsal joint. The hind toe is short, the middle toe long, and joined to the outer one by a large membrane, and by a smaller to the inner toe. The claws are short, blunt, and entire. Fig. 1916 represents the Bill of the Stork. The birds of this genus are gregarious and migratory; they mostly prefer flat marshy countries, and feed upon frogs and other reptiles, mice, moles, worms, insects, and eels. Their appetite is, in fact, extremely voracious. In the countries frequented by them they are held in high regard for the sake of their utility, and are accordingly protected.

The range of the Common or White Stork (Cicogne blanche, Buffon; Weisser Storch, Meyer) is very extensive, being everywhere a bird of migratory habits. The vast flocks that have visited Europe, and sojourned there during the summer, collect together, and wing their way for the warmer parts of Asia and Africa, there to pass the winter. Belon states, that when in Abyssinia, during the month of August, a great flight of storks came from the north, and when they reached the commencement of the Mediterranean Sea, they there made many circuitous turns, and then dispersed into smaller companies; and Dr. Shaw informs us that when he was journeying over Mount Carmel he saw the annual migration of those which had quitted Egypt, and that each of the flocks was half a mile in breadth, and occupied three hours in passing over. Their course is usually unattended with any noise, excepting that of their wings; but when anything occurs to startle them or engage their attention, they make an extraordinary clattering noise, which may be heard to a great distance, by striking the mandibles quickly and forcibly together.

The stork breeds in Turkey, Syria, Greece, and Egypt, but it also visits Europe, and is common in Holland and Germany, extending its migrations to Sweden and Northern Russia. In Seville it is abundant; but, according to the Prince of Canino, is only an accidental visitor near Rome.

When we consider how abundant the stork is in Holland, and that it extends its migrations to more northern latitudes, it is somewhat surprising that individuals should so rarely visit our marshes,—perhaps it was formerly more common than at present, and its rarity may be attributed partly to the drainage of our great morasses and partly to the persecution which it would assuredly bring down upon itself by such an untoward visit, whereas on the Continent it has for ages experienced the utmost toleration. In Holland and Germany the stork approaches without fear the dwellings of man, and is treated as a welcome guest; annually returning to the steeple or the turret, or to the false chimney erected by the Hollander for its nest, and which has been the nursery of many a generation.

The stump of a decayed tree is sometimes chosen as the site of the nest; but wherever it takes up its abode it is there respected. In Spain, says Dr. Southey, [the storks build their brood-nests on the towers of churches, and are held sacred; and Dillon states that in Seville almost every tower in the city is peopled with them, and that they annually return to the same nests. One of the causes of their being venerated is their destroying all the vermin on the tops of the houses. At Bagdad, Niebuhr says, hundreds of these birds are to be seen there on every house, wall, and tree, quite tame. We are told by Fryer that they are so exceedingly numerous among the ruins of Persepolis, that the summit of almost every pillar of these magnificent monuments of antiquity contains a stork's nest (Fig. 1917).

It would appear that the Turks hold this bird in more than usual esteem, their name for it is Hadji Lug-lug: the former word, which is the honorary title of Pilgrim, it owes to its migrations and apparent attachment to their sacred edifices; the latter is a word formed in imitation of the noise which the bird makes. The regard of the Turks is so far

understood and acknowledged by the stork, that in cities of mixed population it rarely builds its nest on any other than a Turkish edifice. The Rev. J. Hartley, in his 'Researches in Greece and the Levant,' remarks, "The Greeks have carried their antipathy to the Turks to such a pitch that they have destroyed all the storks in the country: on inquiring the reason, I was informed, 'The stork is a Turkish bird; it never used to build its nest on the house of a Greek, but always on that of a Turk.'"

Where convenient buildings are not to be found, the stork will construct its nest on the flat shelf-like masses of branches and foliage presented by the fir or cedar. The nest is made of sticks and twigs, and is a solid compact mass, lasting for many years; it is lined with reeds, grasses, and moss. The eggs are from three to five in number, and of a creamy white; in size equalling those of the goose. Incubation continues for a month, at the expiration of which period the young are hatched, and assiduously attended to by the parents until they are fully feathered and able to depend upon their own exertions.

Elevated on its stilt-like legs, the stork walks slowly and with measured steps, traversing the marsh in quest of frogs and other reptiles, small mammalia, and even the young of various waterfowl, on which it preys. It clears the streets of carrion and offal. Previously to their autumnal return to the south, which occurs towards the close of August or at the beginning of September, the storks of a district assemble together, till at length vast flocks are gradually collected; all is bustle and commotion; they make short excursions, and keep up a continual clattering of their bills, under the excitement of the contemplated voyage through the upper regions of the air. On some favourable night they mount up into the sky, and sail away towards their destined haven, returning to their old familiar haunts and a hearty welcome in March or April.

The stork stands nearly four feet high in its ordinary attitude, and measures three feet six inches in length from bill to tail. The eyes are surrounded by a small black naked space, which does not join the bill. The general plumage is pure white, except ing the quills, greater wing-coverts, and scapularies, which are black. Bill and legs red-iris brown.

During repose the stork sleeps like the crane, always standing balanced on one leg, with the neck bent, and the bill resting on the breast.

1918.—The Jabiru

(*Mycteria Americana*). The gigantic storks of this genus, of which one is American, one Asiatic, and one Australian, are characterized by the greatest part of the head and neck being destitute of feathers; the bill, which appears to be somewhat turned up at the extremity, owing rather to the curvature of the lower mandible than of the upper, is large, elongated, sharp-edged, and strong; the upper mandible is nearly if not quite straight and trigonal. Length from the forehead to the tip, upwards of thirteen inches. Nostrils basal and linear. Anterior toes united at the base by a membrane. Habits closely resembling those of the stork.

The Jabiru inhabits the borders of lakes and morasses in South America, where it feeds upon reptiles, fish, small quadrupeds, &c. It is of gigantic stature, standing between four and five feet high, and is endowed with great power in the head and neck, its long sharp bill being a formidable spear-like weapon. The general colour of the plumage of this species is white; the occiput is feathered, but the rest of the head and the neck are naked, the skin being black, with a tinge of red about the lower part of the latter.

1919, 1920.—The Adjutant, or Argala

(*Leptoptilos Argala*). Ciconia Argala, Vigors. In the genus Leptoptilos are placed three gigantic species of stork, distinguished at once by the vast size and volume of the beak, with a proportionate enlargement of skull and muscularity of neck, which, together with the head, is bare of feathers, and only sprinkled with scattered hairs or a little down. A large pouch of skin, capable of being inflated, hangs like a loose dewlap from the lower part of the neck, anterior to the breast, giving to the birds an uncouth aspect, and reminding us of some of the vulture tribe, a resemblance which their general form, movements, and carrion appetite tend to strengthen. They are in fact voracious and highly carnivorous, and the structure of the stomach is in accordance with their appetite. The solvent glands are differently arranged from those of any other bird. Instead of being placed round the upper portion of the stomach, they form two circular figures, about one inch and a half in diameter, one placed on the anterior, one on the posterior part of the stomach; each gland is composed of five or six cells, which pour out the solvent fluid through one common tube or duct: the gizzard is lined with a horny cuticle. (Fig. 1921, the Stomach of the Adjutant.)

Some degree of confusion with respect to the identity of the Indian and African species has arisen in consequence of the misappropriation of names by M. Temminck, who applied the term Marabou to the Indian species, whereas it is the native Senegal name of the African species, as Argala is that of the Indian. The term Marabou is given in Europe to the beautiful plumes obtained from each of these birds, but as those of the Indian species are the finest, M. Temminck transferred the name to that bird, and robbing it of its own (viz. Argala), bestowed it upon the African, thus interchanging their respective titles. This point has been ably cleared up in the appendix to Major Denham's 'Travels.'

The Adjutant or Argala is a gigantic bird, measuring from the tip of the bill to the claws seven feet and a half, and in extent of wing from fourteen to fifteen feet, while in its ordinary erect attitude it stands five feet high. The beak is enormously thick and massive, and the gape wide.

This bird is a native of the warmer parts of India, and is to be found near Calcutta: its great voracity renders it extremely useful, and it is not only tolerated, but revered by the natives, who are indignant against those who molest it: it swallows snakes, lizards, frogs, vermin of all kinds, carrion and bones, and with the kites and crows by day, and jackals and hyænas at night, assists in the office of "scavenger public," clearing the streets, lanes, and fields of all sorts of offal. Sir E. Home states that in the craw of one of these birds was found a land tortoise ten inches long, and a large male black cat entire. (Ives's 'Voyage,' p. 184; 'Phil. Trans.' 1813, p. 77.)

The argalas, says Dr. Latham, who was furnished by Mr. Smeathman with the account, are met with in companies, and when seen at a distance, near the mouths of rivers, coming towards an observer, which they often do with their wings extended, may well be taken for canoes upon the surface of a smooth sea—when on the sand-banks, for men and women picking up shell-fish or other things on the beach. One of these, a young bird about five feet high, was brought up tame, and presented to the chief of the Bananas, where Mr. Smeathman lived; and, being accustomed to be fed in the great hall, soon became familiar, duly attending that place at dinner-time, placing itself behind its master's chair, frequently before the guests entered. The servants were obliged to watch narrowly and to defend the provisions with switches; but, notwithstanding, it would frequently seize something or other, and once purloined a whole boiled fowl, which it swallowed in an instant. Its courage is not equal to its voracity, for a child of eight or ten years old soon puts it to flight with a switch, though at first it seems to stand on its defence, by threatening with its enormous bill widely extended, and roaring with a loud voice like a bear or tiger. It is an enemy to small quadrupeds, as well as birds and reptiles, and slily destroys fowls or chickens, though it dares not attack a hen openly with her young. Everything is swallowed whole; and so accommodating is its throat, that not only an animal as big as a cat is gulped down, but a shin of beef broken asunder serves it but for two morsels. It is known to swallow a leg of mutton of five or six pounds, a hare, a small fox, &c. After a time the bones are rejected from the stomach, which seems to be voluntary, for it has been known that an ounce or two of emetic tartar given to one of these birds produced no effect. ('Gen. Hist. of Birds,' ix. 40, 41.)

General colour above ash grey; under parts white. The under tail-coverts delicate and floating, forming plumes of the most exquisite texture.

1922.—The Marabou

(*Leptoptilos Marabou*). Ciconia Marabou, Vigors, not Temminck. The beak of this species is represented at Fig. 1923.

The Marabou is smaller than the Argala; it is a native of tropical Africa, and the neighbourhood of the large towns of the interior, where it was seen by Major Denham, in the character of a privileged visitor, on account of its utility as a scavenger. It is easily domesticated, and becomes annoyingly familiar; it has been known not only to snatch pieces of meat from the table, but a boiled fowl, swallowing it at a bolt. The marabou flies high, and roosts in the topmost branches of tall trees, whence, as from a watch-tower, it looks abroad for its prey.

The third species is a native of Java and Sumatra, where it is called, according to Marsden, Boorong Cambing, or Boorong oolar. It is described by Dr. Horsfield as the Ciconia Javanica (Leptoptilos Javanicus).

Family TANTALIDÆ (IBIS, TANTALUS).

In the birds of this Family the beak is arched, the apex blunt, the upper mandible channelled; some portion of the head, sometimes the head and neck, are destitute of feathers. Habits closely resembling those of the stork.

1924.—The Glossy Ibis

(*Ibis Falcinellus*). Tantalus Falcinellus, Linn.; le Courlis vert of Buffon; Green Ibis, Latham; Glossy Ibis of the same.

This species, probably the black ibis of Herodotus, and celebrated for destroying snakes, whence it was one among the sacred birds of Egypt, is migratory in its habits, annually visiting the borders of the Danube, Poland, Hungary, and Siberia, and occasionally other countries still more to the west; sometimes even appearing in our island. It is common through the greater part of Asia and Africa, and its remains, with those of the sacred ibis, are found amongst the mummies of the Egyptian catacombs.

The glossy ibis lives in societies, and its migrations are performed in numerous flocks. It frequents the banks of rivers and lakes, and grounds recently inundated, feeding on reptiles, worms, insects, and also aquatic plants. Its general colour above is glossy greenish black, with a metallic lustre, under parts bright chestnut; a naked skin extending from the bill to the eye is green; bill and legs blackish green.

1925, 1926.—The Sacred Ibis

(*Ibis religiosa*, Cuv.). Tantalus Æthiopicus, Latham; Abou Hannès, Bruce. This species is no doubt the white ibis of Herodotus, described as being "familiar with man, and having no feathers on the head and neck; white all over, except the head and neck, the tips of the wings, and the end of the rump, which are very black."

It is to the celebrated traveller Bruce that we owe the recognition of this species as the sacred ibis, abundantly represented on Egyptian monuments, but which had been regarded by Linnæus as the Tantalus Ibis, a species which, as Cuvier observes, is not of common occurrence in Egypt, but is brought from Senegal. The views of Bruce have since been amply confirmed by Geoffroy, Savigny, and Baron Cuvier, as well as by other naturalists.

The Sacred Ibis, called in Upper Egypt and Ethiopia Abou Hannès, or Father John, and by the people of Lower Egypt Abou-menzel, or Father Sicklebill, visits that country, being a migratory bird, as soon as the waters of the Nile begin to rise; and their numbers increase with the spread of the inundation, and diminish as it subsides. On their first arrival, they repair to the low lands over which the water is beginning to flow, and as its depth and extent augment, they gradually retire to higher grounds, and spread themselves along the sides of canals and watercourses which intersect the cultivated country.

This species lives either solitary or in small companies of eight or ten individuals, which may be seen leisurely walking about, or exploring the humid ground and mud in quest of food, which consists of land and fresh-water shells, which are swallowed whole, together with worms, insects, and small reptiles. Its flight is lofty; and, as it sweeps along from one spot to another, it utters at intervals a hoarse loud cry.

Where the Sacred Ibis breeds does not appear to be ascertained: most probably in the central parts of Africa. Salt, on rounding Cape Guardafui from the south, saw near the coast a lagoon abounding in wild-fowl, and on the borders of it stood numbers of these birds, which, as he says, are called Abou Hannès by the Arabs, the true Ibis of the Egyptians, as described by Herodotus, a fact proved by the head and neck being bare and of a deep black colour. "It may be worthy," he adds, "to remark that Strabo mentions this bird as frequenting the coast to the east of the Straits of Babelmandeb." It has been a matter of dispute whether this ibis kills and devours snakes, or the contrary, Herodotus having stated that armies of flying serpents, the bones of which he saw in incredible multitudes in a narrow gorge between two mountains in a part of Arabia, a little beyond the city of Butus, were intercepted every spring by the ibis, and destroyed. It would appear, however, that it was not by this bird, but by the black ibis, that this feat was annually performed. That both birds may swallow small snakes we cannot doubt; but the narration of Herodotus carries with it its own refutation. He saw the bones of snakes in incredible multitudes, whence it may be inferred that the reptiles in question were not devoured at all; and we cannot suppose the ibis would kill them for any other object than that of preying upon them. It is evident that Herodotus was himself imposed upon: he describes the serpents, which he does not say he had seen alive, as resembling the water-snake, but with wings destitute of feathers, and smooth like those of a bat. M. Savigny found in the crops of the fresh-killed specimens of the sacred ibis, which he examined in Egypt, only land and fresh-water shells (Cyclasto-


1925.—Sacred Ibis.


1923.—Bill of Marabou


1926.—Sacred Ibis.


1919.—Adjutant.


1920.—Adjutant.

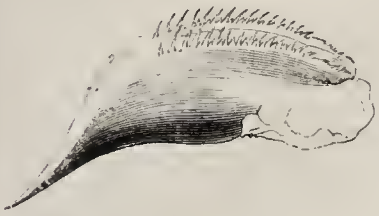

1924.—Glossy Ibis.


1922.—Marabou.


1921.—Stomach of Adjutant.

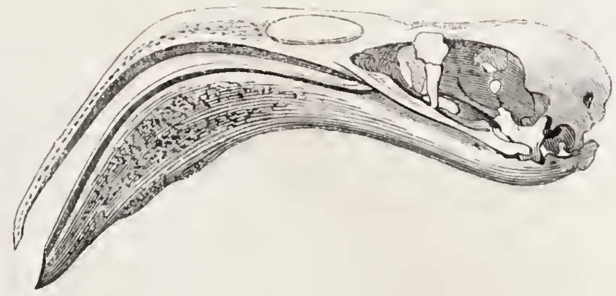

1918.—Jabiru.

1932.—Head and Tongue of Flamingo.



1931.—Tongue of Flamingo.

1936.—Little Flamingo.



1930.—Skull of Flamingo.

1927.—Bill of Spoonbill.

1928.—Head of Spoonbill.

1929.—Spoonbill.

1933.—Flamingoes.

1934.—Flamingo.

ma'a, Ampullariæ, Planorbæ); but, on the other hand, Cuvier detected the remains of the skin and scales of snakes, still undigested, in one of the mummies of the ibis, which he deposited in the anatomical gallery of the Paris Museum. We again repeat it, that, though the story told by Herodotus is unworthy of serious notice, both this species and the black ibis may devour small serpents and other reptiles. The Ibis religiosa, says Cuvier, "was entertained in the temples of ancient Egypt with the observances of religious worship, and after death was embalmed, and this because, according to some, it devoured the serpents which would become the pests of the land; according to others, because there was some similitude between its plumage and one of the phases of the moon; and finally, because, according to others again, its appearance announced the rise of the Nile." The last was probably the true reason.

The sacred ibis is about the size of a fowl; in its immature state the neck is partially covered with down of a blackish tint, which disappears when the plumage is mature, leaving the head and neck bare, which, with the beak and legs, are of a decided black colour. The general plumage is of a pure white, with the exception of the tips of the quill-feathers, which are of a glossy black, with violet reflexions; as are also the last four secondaries, which have the barbs singularly elongated and silky, so as to form a graceful plume, hanging down over the wings and tail, presenting an effective contrast with the purity of the rest of the plumage.

Family PLATALEIDÆ (SPOONBILLS).

In this group the singular form of the bill at once arrests attention; it is long, powerful, gradually flattening from a stout base, and at last expanding into a rounded shovel-like termination. The upper mandible is transversely marked with slight furrows, and channelled along its edge from each nostril, which has an upper site, near the base of the mandible. The form of the nostrils is oblong. The face is more or less naked. The limbs are long and robust. The three anterior toes are united by a web as far as the second joint. The wings are long and ample. The feathers of the neck are very close-set. Figs. 1927 and 1928 represent the Beak of the Spoonbill. The birds of this group are shy and retiring, and live in society in wild wooded marshes, about the borders of lakes and the mouths of rivers, but rarely visit the sea. Their food consists of fishes, mollusks, small reptiles, the larvæ of aquatic insects, &c. They generally build on trees, but occasionally in bushes, or even amidst the luxuriant vegetation of the swamp.

It is not till the third year that the young assume the colouring of the adult; and the beak, which is covered with a vascular membrane, gradually acquires its full dimensions and hardness.

1929.—THE COMMON SPOONBILL

(*Platalea leucorodia*). Pale, Poche, Cueillar, Truble, and Spatule blanche of the French; Becquaroneglia and Cucchiarone of the Italians; Weissar-Laffler and Laffelgans of the Germans; Lepelaar of the Netherlanders; y Llydon big of the ancient British.

The common spoonbill is widely spread over Europe, the adjacent districts of Asia, and Africa. It visits Holland every spring in considerable numbers, migrating with the storks; and is also to be found in the marshy districts of France. It is essentially a bird of passage, resorting in winter to Africa, where it extends its range southwards, even to the Cape of Good Hope, frequenting the mouths of rivers and marshes; in our island it rarely makes its appearance. Pennant mentions a large flight which arrived in the marshes near Yarmouth, 1774. Montagu records it as having been sometimes seen during winter on the coast of South Devon, and mentions the receipt of two specimens from that part of the country, one in November, 1804, and a second in March, 1807. Dr. Latham mentions an instance of its occurrence on the Kentish coast. Mr. Yarrell records two specimens which were shot in Lincolnshire, in 1826; and Mr. Selby states that, when in London, in May, 1830, he obtained a male and female, in fine adult plumage, from Norfolk; adding, "From the time of the year at which these birds were killed, it is not improbable that they would have remained to breed in the district selected; and though my collection has profited by their capture, I must still regret that they were not allowed to remain in security." The food of this bird consists of the fry of fishes, aquatic worms, mollusks, insects, and the roots of some weeds and grasses, in quest of which it explores the muddy water with its broad bill, at the same time rapidly opening and shutting the mandibles. The flesh of the spoonbill is said very nearly to resemble that of a goose, without any fishy or unpleasant flavour. In its anatomy, says Mr. Selby, this bird shows an affinity to the cranes; the windpipe previous to entering the chest assumes a double flexure, to the extent of about two inches, forming a convolution similar to the figure 8; the flexures touch, but do not cross each other, the points of contact being united by fine membranes. Temminck and others have supposed that this peculiarity was to be found only in the male; but, as is now well known, it equally occurs in the female. The nest of this species is sometimes placed on trees, sometimes in rushes and reeds; the eggs are generally three in number, white, and usually marked with obscure red spots. The general plumage of the spoonbill is white, with the exception of a broad pectoral mark of ochreous yellow, which extends round the base of the neck; the naked skin round the eyes and throat yellow, but on the lower part of the latter slightly tinged with red. Bill black, bluish in the hollow of the furrows, and ochreous yellow at the apex. Iris red; legs black. Length two feet six inches. Length of bill eight inches and a half. Head with a fine crest of long slender feathers, which can be raised or depressed at will. The female is somewhat smaller, with a less developed crest, and a paler chest-mark. The young have no crest; the undeveloped bill is soft and flexible, about four inches long, and covered by a smooth ash-coloured skin; the naked parts of the head are of a dull white. The general plumage is white, excepting the quills, which are black along the shafts and at their ends. The yellow patch on the chest does not appear till the second or third year.

Family PHŒNICOPTERIDÆ (FLAMINGOES).

Elevated as are the legs of these birds, a consideration of many important points in their structure will at once convince, that of all the Grallatorial or Wading order, they approach by far the nearest to the true swimming birds (Natatores). We may here allude to Professor Owen's account of the anatomy of the Flamingo, in the 'Proceeds. Zool. Soc.' 1832, p. 141; which it would be out of place to follow in a work like the present, though not to have noticed it would have been unpardonable.

We cannot describe the beak of the flamingo better than by saying it is that of a swan bent down abruptly in the middle, with the sides of the lower mandible raised boat-like, so that its margin may follow the abrupt arch presented by the edge of the upper, which is channelled on each side on the upper aspect of the margin, from the nostrils to the hard nail-like apex. To enter into detail, we may observe, that the head is small, surmounting a slender neck of extraordinary length, while the beak is so modified as to be used in the contrary position to which it is in general, that is, the upper mandible is applied lowermost to the mud and ooze while the bird is searching for food. The upper mandible proceeds for about half its length from the head straight, with an obtuse upper ridge, and in the part below the ridge is an extensive membranous nasal fossa, on which are seated the nostrils in the form of longitudinal slits; the mandible then becomes flat, and bends down abruptly, terminating in a blunt and somewhat incurved apex. The lower mandible, extending forwards and describing on its lower margin a gentle curve, throws up its sides, which describe a bold arch, the edge fitting the edge of the upper mandible. The edges of both mandibles are furnished with fine, close, transverse, tooth-like laminæ, which form a sort of filter, and, as Professor Owen says, like the plates of whalebone on the whale, allow the superfluous moisture to drain away, while the small mollusca and other littoral animalcula are detained and swallowed. "The tongue," says the same writer, "is remarkable for its texture, magnitude, and peculiar armature. It is almost cylindrical, but slightly flattened above, so as to correspond with the form of the inferior mandible. The lower part of the truncated surface is produced in a pointed form, and is supported beneath by a small horny plate. The whole length of the tongue is three inches, its circumference two inches and a half. Along the middle of the superior flattened surface there is a moderately deep and wide longitudinal furrow, on either side of which there are from twenty to twenty-five recurved spines, but of a soft and yielding horny texture, measuring from one to three lines in length. These spines are ranged in an irregular alternate series, the outer ones being the smallest, and these indeed may be considered a distinct row. At the posterior part of the tongue there are two groups of smaller recumbent spines, directed towards the glottis. The substance of the tongue is not muscular, but is chiefly composed of an abundant yielding cellular substance with fat of an almost oily consistence. It is supported by a long and thin concave cartilage articulated to the body of the os hyoides." Fig. 1930 represents the Skull and Beak of the Flamingo; Fig. 1931, the Tongue; Fig. 1932, the Head and Tongue of the same. In the flamingo the legs are of excessive length; the three anterior toes are fully webbed; the hind-toe is short, and articulated high on the tarsus; nails short and flat; wings moderate. These birds are waders in their habits, but occasionally swim when out of their depth. They frequent low muddy coasts, the mouths of large rivers, saline morasses, creeks, lagoons, inland seas, and large lakes.

1933—1935.—THE FLAMINGO

(*Phœnicopterus ruber*, Linn.). Phœnicopterus antiquorum, Temminck; le Flammant of the French. The European Flamingo, a bird well known to the ancients, has been occasionally observed on the coast of France washed by the Mediterranean, of those of Spain and Italy. It is noted by the Prince of Canino as a rare and accidental visitor near Rome. It arrives at uncertain times, but mostly in October and November, on the Persian side of the Caspian Sea, and thence along the west coast as far as the Wolga, appearing in considerable flocks, which have migrated from more northern latitudes. It is found in India, and Colonel Sykes enumerates it among the birds of the Dukhun, stating that it is called Rajah Huns by the Hindoos. It breeds in the Cape de Verde Islands. It is seen everywhere on the African coast, and is abundant in South Africa; Le Vaillant saw thousands of flamingoes and pelicans on the river Klein-brak, where the water is brackish owing to the tidal flow from the ocean. Kolben also speaks of their numbers at the Cape, where by day they resorted to the borders of lakes and rivers, and lodged at night among the long grass on the hills.

The flamingo is extremely shy, wary, and distrustful, so that it is difficult to approach within gun-shot of a flock, as on the slightest alarm they abruptly leave the spot. Dampier, however, by concealing himself, managed to kill fourteen at once. Whilst feeding, those birds keep together, drawn up in lines, with sentinels by way of security. These notify the approach of danger by a loud trumpet-like noise, which may be heard to a great distance, upon which the whole flock take wing. When flying, they form a triangle. The flamingo rests standing on one leg, the other being drawn up close to the body, and the head placed under the wing.

M. de la Marmora, in his 'Voyage to Sardinia,' gives the following account of the habits of this remarkable bird:—"It quits Sardinia about the end of March, to return about the middle of August; then it is that from the bastion which forms the promenade of the inhabitants of Cagliari, flights of these magnificent birds may be seen to arrive from Africa. Disposed in a triangular band, they appear at first in the heavens like a line of fire; they advance in the most regular order, but at the sight of the neighbouring lake there is a pause in their progression, and they appear for a moment immoveable in the air; then tracing by a slow and circular movement a reversed conical spiral figure, they attain the end of their migration. Brilliant in all the splendour of their plumage, and ranged in a line, these birds offer a new spectacle and represent a small army ranged in order of battle, the uniformity and symmetry of which leaves nothing to be desired; but the spectator should content himself with observing this peaceful colony from afar. Woe to him if he dare approach the lake at this deadly season." The exemption of various animals, the flamingo and buffalo for example, from the poison of the malaria, so fatal to man, is very remarkable.

The flamingo makes a singular nest, constructing it of earth, in the shape of a hillock, with a cavity at the top; the eggs are two or three in number, white, and as large as those of a goose, but of a longer figure. These hillocks they form in the marshes, the female resting upon them during incubation in a standing attitude, with the feet on the marshy ground, or even in the water. Some state that the flesh of the flamingo is excellent, that of the young being equal to partridge. The inhabitants of Provence, however, affirm that it is fishy, and reject it, preserving only the feathers. The Romans, whose taste in culinary matters seems to have been singular, regarded this bird as a luxury, and Apicius has left receipts for dressing it with all the precision of a "chef de cuisine." The brains and tongues were especial favourites, particularly the latter, which formed one of the celebrated dishes of Heliogabalus. Dampier confirms the opinion of the Roman epicures, observing that a dish of these tongues is worthy a place at a prince's table. The height of the flamingo, standing erect, is between five and six feet. When in full plumage the general colour is deep scarlet, excepting the quill-feathers, which are black. Basal part of the bill reddish yellow; the greater part of the extremity black; cere at the base of the bill, extending to the eye, flesh-coloured. Legs red. An allied species, regarded by Linnæus and Wilson as identical with the present, is an inhabitant of the warmer parts of North America, Peru, Chili, Cayenne, the West India Islands, and especially the Bahamas, where numbers breed. It scarcely differs from the Old World bird, but is not so intensely coloured;

its manners are precisely the same. It is the Phœnicopterus Chilensis of Molina, and the Ph. ruber of Brisson and Bonaparte.

1936.—THE LITTLE FLAMINGO

(*Phœnicopterus parvus*). This species is a native of Africa, tenanting morasses and the borders of lakes. Specimens have been brought from Senegal and the Cape of Good Hope. The lower mandible is remarkable for its great depth, and the boldness of the arch formed by the upper edges, which completely receive within them those of the upper mandible. The plumage of the adult is of a pure rose, without a spot or streak, the centre of the wing-coverts deepening into scarlet; tail-feathers black; base of the bill, cere, and region of the eye deep purple; middle of the lower mandible orange-red, point black; tarsus livid; toes and space above the tarsal joint red. Total length nearly three feet. The young are white or whitish, marked with streaks of brown on the head, neck, chest, and wing-coverts. The rose tint first begins to appear on the wings. Bill black. Legs reddish livid.

ORDER NATATORES.

This order, agreeing with the Anseres of Linnæus, contains those families of birds which display decidedly aquatic habits; which swim with facility, haunting rivers, lakes, and seas, and whose whole whole structure adapts them for their appointed station. Hence have they obtained the expressive name of Waterfowl. As a rule it may be observed that the birds of this order are awkward on the land, and the more so the more exclusively they tenant the water; for, in order to the stroke of their paddle-feet being as effective as possible, the limbs are placed behind the centre of gravity, and thrown, as for instance in the Grebes, as far backwards as possible, and the tarsi are short and compressed. Hence on the ground these birds have either to maintain their balance by dint of continual muscular exertion, as we see in the swan when it labours over the grassy bank, or, as in the grebe, they are obliged to assume an erect attitude. The feet are webbed, but in a different manner in different families. Among the waders, the Phalaropes, in the structure of their feet, approach nearest to certain groups, while others are fully webbed; and these the flamingoes, among the waders, the most completely resemble. In order to make the stroke, the foot is first drawn forwards, when the toes close together and the webs fold, so as to offer to the water the least possible resistance; but when the back-stroke is made, the toes spread out, while the action of the limb is at the same time (in most instances) obliquely outwards.

Fig. 1937 represents the Feet of three Water-birds, and of the Phalarope, by way of comparison: *a* is the Foot of the Diver (Colymbus); *b*, that of the Cormorant; *c*, that of the Grebe, divided into distinct oar-blades, capable of overlapping each other; *d* is the lobated Foot of the Phalarope, approximating to a webbed character.

The form of the body in the water-birds is boat-like; and in those that dive, the ribs are strong, and carried down so as almost entirely to surround and defend the internal viscera from undue pressure. The plumage is thick, close, and water-proof. There is a dense under-garment of down, overlaid by large, sometimes silky, feathers, which throw off the water as if their surface was oiled. In many the neck is long, and the tail very short; in some the tail, composed of rigid feathers, acts as a rudder in the act of diving. A few are utterly incapable of flight, but use their wings as paddles in the water. From this order man has reclaimed several species for the sake of their flesh, which is excellent.

Family ANATIDÆ (DUCKS, SWANS, &c.).

The family Anatidæ comprehends the Swans, Ducks, Geese, and Mergansers, distinguished by webbed feet with the hind-toe free, and a depressed nail-pointed bill, the mandibles being covered with a sort of tough skin, and having laminated edges, very similar to what we have contemplated in the Flamingo.

We place in juxta-position with these birds a specimen of that extraordinary animal the Ornithorhynchus of Australia (Fig. 1938), in order to show how, even among creatures coming within the pale of the Mammalia, organization is adapted to particular habits and instincts. In this quadruped, which in many anatomical details approaches the reptiles, but which is aquatic, and feeds like a duck, squashing by a rapid action of the mandibles the mud and water through the beak, and retaining insects and mollusks, we find the feet largely webbed, and the mouth transformed into a beak approximating in shape to that of one of these birds, covered with a sensitive tough skin, and laminated on the edges. We can easily pardon those who, when the discovery of this strange quadruped was first announced, were inclined to believe that a fabricated creature, which had no real existence, had been prepared, compounded of the beak and webbed feet of some water-fowl, and the skin of a young otter, or other animal, and imposed upon the too credulous naturalists of our country.

To return from the beak of the Ornithorhynchus to that of the duck, we may observe that it is at once a feeler, a strainer, and an organ of prehension. It is highly sensitive, and feels out food in the mud, where it is used with singular address. The skin, and especially the margins of the mandibles, are freely supplied by fine branches of the fifth pair of nerves (see the Skull of the Duck, Fig. 1939), which endow it with a discriminating sensibility.

We have said that it is a strainer, the edges being laminated, or furnished with close-set, transverse lamellæ. These in some are more developed than in other species, and in the Shoveller Duck (Rhynchaspis Clypeata, Leach. Spathulea Clypeata, Fleming) this lamination is at its maximum, and presents the appearance in both mandibles of a fine pectinated appendage, accompanied with great dilatation and depression of the front part of the bill, which is spatulate, or spoon-shaped. At Fig. 1940, *a* represents a section of the upper mandible of the Shoveller, showing the development of the lamination; while *b* represents the lower jaw of the Common Duck.

In accordance with the sensibility and structure of the beak in the Anatidæ, is the tongue modified. It is also a sensitive organ, and, instead of being slender and horny, is large and fleshy, and furnished on its margin and other parts with rough appendages. The tongue, in fact, co-operates with the mandibles in the discrimination and appropriation of food.

Among other points to be noticed is the structure of the trachea, which in certain groups presents in the male a singular osseous drum, or capsule, just before its bifurcation, differing in form according to the species. In other forms, again, the trachea is singularly convoluted before entering the chest. The gizzard is strong and muscular; in many species it is of enormous volume, and lined with a very thick, tough, or almost horny coat, and is capable of grinding down the shells of mussels and other mollusks, on which they live, and for which they dive with wonderful rapidity: we refer to such species as the Scoter-Ducks (Oidemia) and the Eider-Ducks (Somateria), birds which tenant the sea. The Anatidæ are dispersed over every part of the globe, and are generally migratory in their habits. Their flight is vigorous and rapid, and the flocks assume during their aërial progress, definite figures, as lines or wedges; generally at a very great altitude.

Fig. 1941 represents a Group of Water-fowl:—*a*, the Teal (Querquedula Creeca, Stephens): *b*, the Wigeon, male and female (Mareca Penelope, Selby); *c*, the Tame Swan (Cygnus Olor); *d*, the Mallard, or Wild Duck, male (Anas Boschas, Linn.); *e*, the Tame Duck, male; *f*, the Muscovy Duck, or Musk Duck (Anas moschata); *g*, the Domestic Goose (Anser palustris, Fleming; Anser cinereus, Meyer).

Of the Family Anatidæ we shall first direct our attention to the Swans, which constitute a distinct and well-defined group, comprising several species.

1941, *c*.—THE TAME SWAN

(*Cygnus olor*). Cygne of the French; Cigno and Cigno reale of the Italians; Schwan and Höcker Schwan of the Germans; Tam Svane of the Danes; Alarch of the Welsh; Swan and Mute Swan, English. The genus Cygnus is characterized by the beak being of equal breadth throughout its length, higher than wide at its base, and depressed at the point; both mandibles furnished along the edge with transverse lamellæ; nostrils oblong and lateral near the middle of the beak. Neck slender and very long; legs short; the hind-toe small and free.

The tame or mute swan, so well known in a state of semi-domestication on our ornamental sheets of water, our lakes, meres, and large rivers, of which it is so conspicuous an ornament, is not an aboriginal of our islands, but is found in the eastern portions of Europe and the adjacent parts of Asia, where inland seas, vast lakes, and extensive morasses afford it a congenial home. In Siberia and some parts of Russia it is common, and abounds on the shores of the Caspian Sea. It is migratory in its habits.

When this graceful bird was introduced into England we cannot ascertain; we find, however, that at an early period it was regarded as royal property, and under the protection of authorized swan-herds, or masters of the King's swans, while the stealing of one of these birds, or of the eggs of swans out of their nests, was punished with great severity.

The following observations relative to the right of keeping swans are taken from the 'Penny Cyclopædia;' they are evidently drawn up by one of the "juris legumque periti," and the references are made to some works which we have never read:—

"In England the swan is said to be a bird royal, in which no subject can have property, when at large in a public river or creek, except by grant from the crown. In creating this privilege, the crown grants a swan-mark (cygninota), for a game of swans, called in law Latin deductus (a pastime, un déduit) cygnorum, sometimes volatus cygnorum. (7 Coke's *Rep.*, 17.) In Scotland the swan is said not to be a royal bird (Erskine's *Instit.*, b. ii., tit. 6); but whilst all proprietors in that country have the right of fowling within their own grounds, swans, unless specially granted, appear to be reserved to the crown. (Stair's *Instit.*, b. ii., t. 3, s. 60: and see Ducange, *Cygnos habendi jus*). In the reign of Elizabeth upwards of 900 corporations and individuals had their distinct swan-marks, some of which may be seen in Yarrell's 'British Birds,' vol. iii., 121, &c.

"Sometimes, though rarely, the crown, instead of granting a swan-mark, confers the still greater privilege of enjoying the prerogative right (within a certain district) of seizing white swans not marked. Thus the Abbot of Abbotsbury in Dorsetshire had a game of wild swans in the æstuary formed by the Isle of Portland and the Chesil Bank. The swannery at Abbotsbury is the largest in the kingdom, which, though formerly considerably more extensive, still numbers many hundreds of these birds, forming an object of considerable attraction and interest to those who visit this part of the south coast: it is now vested in the Earl of Ilchester, to whose ancestor it was granted on the dissolution of the monasteries. (7 Co. *Rep.* 17; Hutchins, *Dorset*, i. 538.)

"The privilege of having a swan-mark, or game of swans, is a freehold of inheritance, and may be granted over. But by 22 Edw. IV., c. 6, no person, other than the king's sons, shall have a swan-mark, or game of swans, unless he has freehold lands or tenements of the clear yearly value of five marks (3*l.* 6*s.* 8*d.*), on pain of forfeiture of the swans, one moiety to the king and the other to any qualified person who makes the seizure. In the first year of Richard III. the inhabitants of Crowland in Lincolnshire were exempted from the operation of this act upon their petition setting forth that their town stood 'all in marsh and fen,' and that they had great games of swans, 'by which the greatest part of their relief and living had been sustained.' (6 *Rot. Parl.*, 260.)

"The city of Oxford has a game of swans by prescription, though none are now kept. In the sixteenth century (when a state dinner was not complete unless a swan was included in the bill of fare) this game of swans was rented upon an engagement to deliver yearly four fat swans and to leave six old swans at the end of the term. By the corporation books it also appears that in 1557 barley was provided for the young birds at 14*d.* a bushel, and that tithes were then paid of swans.

"Two of the London Companies have games of swans, the Dyers' and the Vintners' Company, and are, with the crown, the principal owners of swans in the Thames. In August, 1841, the queen had 232, the Dyers 105, and the Vintners 100 swans in the river. Formerly the Vintners alone had 500. The swan-mark of the Dyers' Company is a notch, called a 'nick,' on one side of the beak. The swans of the Vintners' Company, being notched or nicked on each side of the beak, are jocularly called 'swans with two necks,' a term which has long been used as a sign by one of the large inns in London.

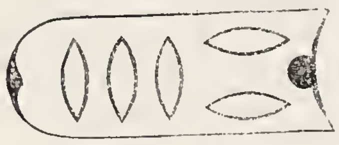
"On the first Monday in August in every year the swan-markers of the crown and the two Companies of the city of London go up the river for the purpose of inspecting and taking an account of the swans belonging to their respective employers, and marking the young birds. In antient documents this annual expedition is called swan-upping, and the persons employed are denominated swan-uppers. These are still the designations used amongst the initiated, though popularly corrupted into swan-hopping and swan-hoppers.

"The swan-markers proceed to the different parts of the river frequented by the swans for breeding, and other places where the birds are kept. They pay half-a-crown for each young bird to the fishermen who have made nests for the old birds, and two shillings per week to any person who during the winter has taken care of the swans by sheltering them in ponds or otherwise protecting them from the severity of the weather."

Fig. 1942 is a representation of the Royal Swan-mark used in the last three reigns, and in the present, given by Mr. Yarrell, in whose valuable work on British birds will be found a mass of curious information on this subject, together with delineations of sixteen different swan-marks.

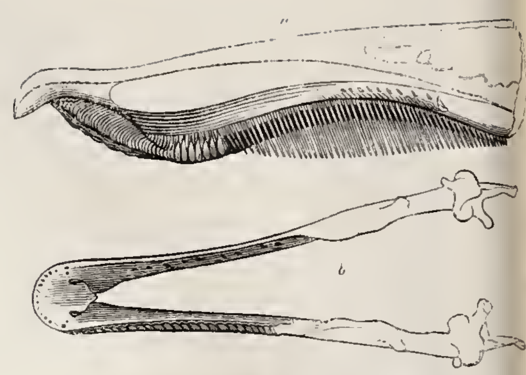
Fig. 1943 represents the Head of the tame Swan (Cygnus olor), remarkable for the development of the black naked cere, at the base which extends to the eye, rising on the anterior part of the forehead in the form of a large prominence, more conspicuous in the male than the female. The beak generally is of an orange red, with the exception of the

1939.—Skull of Duck.



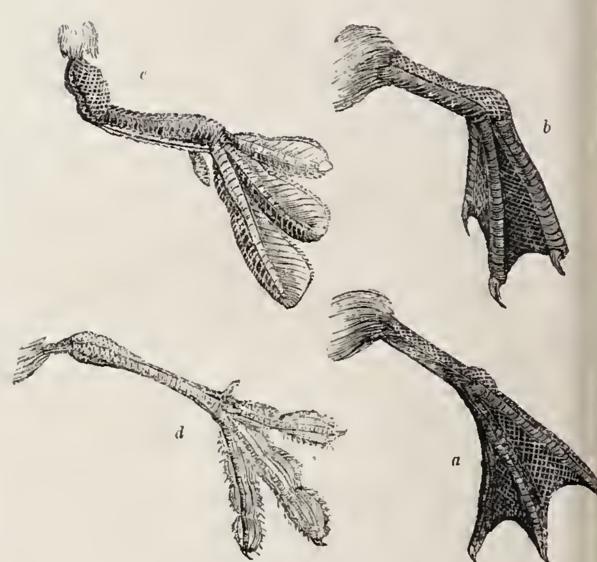
1942.—Royal Swan mark

1935.—Flamingoes and Nest.



1940.—*a*, Upper Mandible of Shoveller; *b*, Lower Jaw of Duck.

1941.—Group of Water-Fowl.



1937.—Feet of Water-birds.

1938.—Ornithorhynchus.

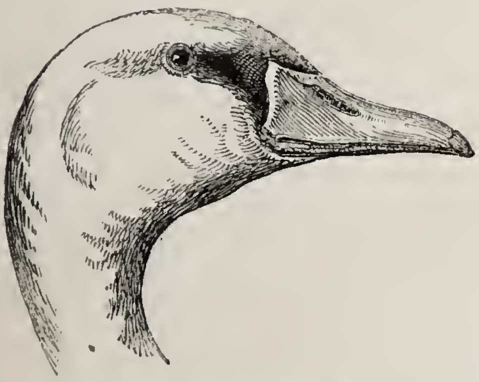
1946.—Head of Hooper.

1950.—Head of Bewick's Swan.

1953.—Head of Black Swan.

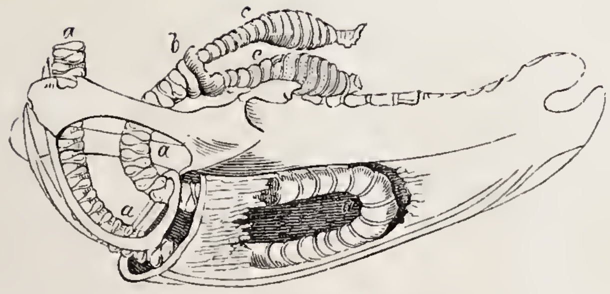
1943.—Head of Tame Swan.

1944.—Richmond Palace in the olden time.

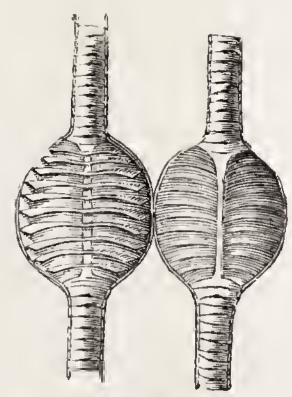


1952.—Head of Polish Swan.

1954.—Breast-bone of Black Swan.



1948.—Breast-bone of Wild Swan.



1951.—Windpipe of Bewick's Swan.

1949.—Point of Keel of the above.

1947.—Breast-bone of Wild Swan.

1945.—Gizzard of Swan.

nail at the tip of the upper mandible, the edges of both, and of the nostrils, which are black.

In a natural state the female swan, sedulously attended by her mate, forms her nest, which is a thick mass of sticks, reeds, flags, and rushes, in the midst of reeds or oziers near the water. The eggs are six or eight in number. The young birds are termed Cygnets, and are covered with a greyish brown plumage, which is not entirely lost till the beginning of the third year. Though the swan is in general very gentle and inoffensive, the male will defend the nest with great courage, and advance to the onset with ruffled pinions and every demonstration of anger, nor is it, from its muscular powers, an antagonist to be despised.

The swan is very long-lived, attaining to the age of even more than thirty years.

In this species the trachea, or windpipe, is simple, and passes into the chest without any previous convolutions.

Fig. 1944 represents Richmond Palace in the olden time, with the Thames flowing before it, when, in numbers more considerable than at present, the swan gave additional charms to the river, and was looked upon as an appendage to the pomp of royalty; for in the 2 Henry IV., c. 21, which directs that no lord shall give any livery or sign to any knight, esquire, or yeoman, there is an express proviso that the prince may give *his honourable livery of the swan* to his lords and to gentlemen his menials. (3 *Rot. Parl.* 478, *a.*)

The swan feeds on aquatic weeds, and coarse grass growing by the sides of rivers and in morasses, and the gizzard, which is very muscular, is well adapted for grinding the fibres to a pulp. Fig. 1945 represents the Gizzard of the Swan opened to show its grinding surface and the zone of gastric glands.

1946.—The Hooper, or Whistling Swan, Head of

(*Cygnus ferus*). Cygnus musicus, Bechstein; Cygne sauvage of the French; Cigno salvatico of the Italians; Singschwan of the Germans; Vild Svane of the Danes; Alarch gwylt of the ancient British.

This species, which differs in many important anatomical details from the preceding, is a native of nearly the whole of the northern hemisphere, as far at least as Europe and Asia extend; for it appears, according to the Prince of Canino, that in the high latitudes of America it is represented by a distinct though closely allied species, the Cygnus Americanus, Sharpless.

The Hooper is a migratory bird, residing during the summer within the regions of the arctic circle, where it breeds in great numbers. It has been known, however, to incubate and rear its young in the Shetland and Orkney Islands. On the approach of winter, this bird leaves the dreary regions of the north for more southern latitudes, visiting the British Islands, Holland, Germany, France, and Italy, extending its journey even to Northern Africa and Egypt. It performs its periodical flight in flocks of greater or less extent, arranged in the figure of a wedge, travelling with vast rapidity, and at a great elevation. The note which it utters while on the wing is harsh, and resembles the word *hoop*, repeated several times successively; yet this cry, when heard from a flock high overhead and softened by distance, is not unmusical. The trachea, or windpipe, of this species is very remarkable. After passing down the long neck of the swan, it descends between the two branches of the merrythought, and instead of then passing into the chest, it enters into the keel of the breast-bone, which is hollowed for its reception; here it extends backwards between the two plates of the keel, nearly throughout its whole extent, then suddenly turning upon itself, it passes forwards, and emerging sweeps round the apical portion of the merrythought, and so again turning back enters the chest, and there gives off two long branchial tubes, one to each lobe of the lungs. In females and young males the extent to which the windpipe enters the keel of the breast-bone is not so considerable. Figs. 1947 and 1948 represent the windpipe and breast-bone, with a portion of the keel removed so as to expose the former: *a*, *a*, the trachea; *b*, the bony ring, or lower larynx, whence are given off *c*, *c*, the two branchial tubes. Fig. 1949 shows the anterior portion of the keel, with the opening for the reception and exit of the trachea.

Wide morasses, lakes or the mouths of rivers, and inundated grounds are the abode of this wary bird. On the first dawn of spring, the flocks which have spread themselves in small parties over our latitudes collect and wing their way back to their northern breeding-haunts, scattering themselves over Norway, Iceland, Lapland, Spitzbergen, and Siberia.

The down of this species is very valuable, and is procured in great quantity by the Icelanders, together with the feathers, not only for domestic comfort, but for the purpose of barter. The season for swan-hunting in Iceland is during the month of August, when the old birds, having cast their quill-feathers, are unable to fly; the natives assemble in bodies in the places where these birds collect, attended by dogs, and mounted upon small but active horses, well trained to pass over bogs and through marshy soil, and many are ridden down, but the greater number are caught by the dogs, which always seize by the neck, a mode of attack that causes the bird to lose its balance and become an easy prey.

The hooper is smaller and much less graceful than the tame swan; in swimming it is never seen to throw up the plumes of its wings, nor assume any striking attitude, and it carries its neck erect and straight, instead of curved; but while walking the head is lowered, and the neck reclines over the back to assist in preserving the equipoise of the body. In captivity it soon becomes tame, and has bred in the Zoological Gardens, but it does not associate with the tame swan.

This species has no basal protuberance on the beak; the base of the upper mandible and cere, as far as the eye, are yellow, as is also the back part of the lower mandible; the point, as far as the nostrils, black—these two colours meet each other obliquely, the latter running obliquely backwards, the yellow advancing forwards along the sides of the beak; iris brown; feet black. Expanse of wings about eight feet.

1950.—Bewick's Swan, Head of

(*Cygnus Bewickii*). This species is about one-third less than the hooper. Its beak rises high at the base, which is yellow; the anterior portion, including more than the nostrils, black; the tail-feathers are eighteen, in the hooper twenty; the legs are of a deeper black than in the hooper, and the neck is more slender. The arrangement of the trachea, besides, is very different. "The tube of the windpipe," says Mr. Yarrell, "is of equal diameter throughout, and, descending in front of the neck, enters the keel of the sternum, which is hollow, as in the hooper, traversing the whole length. Having arrived at the end of the keel, the tube, then gradually inclining upwards and outwards, passes into a cavity in the sternum destined to receive it, caused by a separation of the parallel horizontal plates of bone forming the posterior flattened portion of the breast-bone, and producing a convex protuberance on the inner surface. The tube, also changing its direction from vertical to horizontal, and reaching within half an inch of the posterior edge, is reflected back after making a considerable curve, till it once more reaches the keel; again trasversing which, in a line immediately over the first portion of the tube, it passes out under the arch of the merrythought: where turning upwards and afterwards backwards, it enters the body of the bird, to be attached to the lungs in the usual manner. This is the state of development in the oldest bird I have yet met with. The degree next in order, or younger, differs in having the horizontal loop of the trachea confined to one side only of the cavity in the sternum, both sides of which cavity are at this time formed, but the loop of the tube is not yet sufficiently elongated to occupy the whole space; and the third in order, from a still younger bird, possesses only the vertical insertion of the fold of the trachea." Mr. Yarrell adds, however, that in this last case the cavity in the posterior part of the sternum already exists to a considerable extent.

Bewick's swan is a native of the northern regions of Europe and Asia, as well as of America; though, in his 'Comparative List of the Birds of Europe and America,' the Prince of Canino does not give it as an American species, but parallels it with the Cygnus Buccinator. According to Temminck, it breeds in Iceland, and within the arctic circle, migrating southwards in spring; but it appears to be much scarcer than the hooper.

Captain Lyon describes the nest as constructed of peat moss, nearly six feet long, four and three quarters wide, and two feet in height, with a cavity for the eggs a foot and a half in diameter. Mr. Blackwall describes the cry of this species as loud, and states that a flock of twenty-nine were very clamorous. Mr. Sinclaire says the note of these birds in captivity is a low-toned whistle; and Mr. Selby, "its voice is much weaker than that of the preceding species." Fig. 1951, a portion of the Trachea of Cygnus Bewickii.

1952.—Polish Swan, Head of

(*Cygnus immutabilis*, Yarrell). Till recently this species has been confounded with the Cygnus olor, to which, of all the European swans, it is the most nearly related. There are, however, many important anatomical differences, especially in the osteology of the head. (See paper by W. G. Pelerin, Esq. in 'Mag. Nat. Hist.' 1839, p. 179.) The cygnets are white, a point in which it differs from every other species of white swan. In the adult bird the beak is reddish orange; the lateral margins, the nail, the nostrils, and base of the upper mandible are black. There is a small tubercle, which never acquires the size of that ornamenting the head of the Cygnus olor. Legs, toes, and intervening membranes slate grey. The windpipe is simple. The bird, a native of the high northern regions and the Baltic, is called by dealers the Polish swan, and occasionally visits our island. It is easily reconciled to captivity, breeding as freely as the common tame swan. The female of a pair of these swans, at Lord Derby's seat, Knowsley, having died, the male paired with a female of the ordinary tame species, and a brood was the result, but the hybrids, though old enough, neither paired among themselves nor with any of the tame swans on the same water.

1953.—The Black Swan, Head of

(*Cygnus atratus*, Bennett). Anas Plutonia, Shaw; Chenopis atratus, Wagler.

The black swan, by no means "rara avis in terris," is a native of Australia, where it abounds on the rivers and lakes, and on various islands along the coast, and is usually seen in flocks, which are shy and wary. Of late years this beautiful bird has been introduced into our island, where it thrives and breeds, and will no doubt soon become almost as common as the tame swan. It is irascible in temper, and disposed to tyrannise over the weaker or more timid captives resident on the same piece of water.

The black swan is inferior to the hooper in size; its plumage is black, with the exception of the primary and a few of the secondary quill-feathers, which are white; but these are obscured by the curled secondaries, which hang plumelike over them. The bill is of a bright red colour, crossed near the nail by a whitish band; its base in the male is surmounted by a slight protuberance, which is wanting in the female; under part of the bill greyish white; legs and feet of a dull ash colour; iris red; trachea perfectly simple, not unlike that of the Cygnus olor. Fig. 1954 represents the Trachea and Breast-bone of the Black Swan. The note of this species is harsh.

Various portions of the coast of South America (Chili, the Falkland Islands, Rio de la Plata, &c.) present us with a very beautiful species of swan (Cygnus nigricollis), distinguished by a jet black head and neck, contrasting admirably with the snowy whiteness of the rest of the plumage. The bill is red; the legs and feet flesh-colour. It equals the hooper in size. It has never, we believe, been brought alive to Europe.

From the swans we shall proceed to the ducks, which may be divided, again, into two sections, namely, *fluviatile* and *marine*. The fluviatile ducks have the neck and wings long, the tarsi round, the hind-toe without any lobe or paddle-like membrane; the gizzard is muscular, the ribs short, the keel of the breast-bone deep, an osseous drum at the lower part of the trachea. The birds of this division frequent rivers, lakes, swamps, &c., feeding upon aquatic vegetables, insects, worms, &c.: they seldom dive, unless superficially, and that rather in playfulness, or when hard pressed by danger, than for food. Their flight is powerful and rapid. To the specimens of the fluviatile section of ducks we shall first direct our attention.

1955.—The Shoveller

(*Rhynchaspis clypeata*, Leach). Spathulea clypeata, Fleming and Selby; Anas platyrhynchos, Ray; Canard souchet ou rouge of Buffon; Löffel Ente of Bechstein; Cucchiarone of the Italians; Hwyad lydanbig of the Welsh; Kerlutock, and Broad-bill, Provincial English. In this genus the size and dilatation of the bill at its extremity are very remarkable; the edges are finely laminated, and the hooked nail at the tip of the upper mandible is small. (Fig. 1956, the Bill of the Shoveller.)

The shoveller is a native of the northern regions of Europe, Asia, and America; in Holland it is very abundant. In France, Germany, and England it is a bird of passage, arriving in October and departing northwards in March. A few pairs however occasionally breed both in our island and France; but these may be deemed exceptions to the general rule. In America the shoveller breeds in the fur-countries, visiting the United States in the winter. It is called Mimenick by the Cree Indians. The nest of this species is placed amidst the reeds and tall herbage of marshes and the borders of lakes; the eggs are from twelve to fourteen in number, of a bright olive green. In the male the lower larynx of the windpipe is enlarged, and furnished on the side with a small, thin, bony drum or bladder, of irregular shape.

The flesh of the shoveller is excellent, and by many considered to excel that of the common wild duck. The food of this species consists of aquatic insects, worms, and larvæ; these it procures by sifting the watery mud through the long and finely-set teeth of its curious bill, each mandible being bordered by pectinated rows, exactly resembling, as Wilson remarks, those of a weaver's reed, and which, fitting into each other, form a kind

of sieve capable of retaining very minute worms, seeds, or insects.

The male shoveller is a beautiful bird; its colouring is as follows:—

Head, adjoining half of the neck, medial stripe to the interscapulars, the whole back, and primaries, umber brown; sides of the head, the neck, and the crest glossed with duck green; rump and tail-coverts above and below, with blackish green. Lower half of the neck, the breast, shoulders, shorter scapulars, ends of the greater coverts, and sides of the rump white; longer scapulars striped with Berlin blue, white and blackish brown; lesser coverts Berlin blue; speculum on the wings brilliant grass green, broadly bordered above and narrowly edged below with white; bounded interiorly with greenish black; belly and flanks deep orange brown, the latter undulated posteriorly with black; bill black; legs orange.

The female is liver brown above, the feathers bordered with pale yellowish brown; under parts pale yellowish brown, with obscure liver-brown marks. Lesser coverts slightly glossed with blue; wing spot, or speculum less vivid than in the male. Weight about twenty-two ounces.

Among the broad-billed ducks of the southern hemisphere is that remarkable form to which Mr. Swainson has given the generic title of Malacorhynchus, and which is distinguished by the edge of the upper mandible being furnished with a thin membranaceous skin, projecting considerably on each side, and doubtless very sensitive, while the bill itself is extremely flexible. It is essentially formed for procuring food in mud and semi-fluid ooze.

Fig. 1957 represents the Beak of Malacorhynchus.

1958.—THE GADWALL

(*Chaulelasmus streperus*, G. R. Gray). Chauliodus strepera, Swainson; Anas strepera, Linn.; Chipeau or Ridenne of the French; Anitra montanara and Anatra canapiglia of the Italians; Schwatterente of the Germans; y gors Hwyad lwyd of the Welsh. In this genus the bill is of equal breadth throughout its length, and the laminations of the upper mandible are very fine and well developed. The wings are long; the tail is wedge-shaped. Fig. 1959 represents the Bill of the Gadwall. This beautiful duck is a native of the high northern latitudes of Europe, Asia, and America; in the latter country it was observed, together with the mallard, by Dr. Richardson, breeding in the woody districts up to their most northern limits, in latitude 68°. The gadwall is a migratory bird, visiting Holland, France, and Italy during the winter. In our island it is not common; but, at the period of its vernal passage to the north, appears in the marshes of Norfolk and the adjoining counties, the flocks being probably driven by adverse winds out of their usual course. In Holland it is very abundant. Lakes, rivers, and marshes are the resort of this species, the sea-coast being seldom visited. It is remarkable for rapidity of flight and quickness in diving on the least alarm. Insects and their larvæ, fresh-water shelled mollusks, small fishes, and aquatic plants and seeds constitute its food. Their eggs are from eight to twelve in number, of a pale olive green. The flesh of this bird is held in high estimation. In the male the trachea is slightly enlarged in its diameter, at about two-thirds of its length, but becomes narrower as it approaches the lower larynx: this consists of a large bony arch, with a pyriform drum or bulla attached to the left side, resembling that of the mallard, but smaller.

In the male the head and upper part of the neck are liver brown, the feathers edged with grey; lower part of the neck, breast, and mantle black, with concentric semicircles of white; scapulars, flanks, and sides rayed with zigzag lines of white and blackish brown; lesser wing-coverts grey, marbled with yellowish white; speculum white, with a black anterior border; quills and tail brown; rump, upper and under tail-coverts bluish black; under parts greyish white; bill brownish black; legs orange red. The female has the feathers of the back of a blackish brown, bordered with rufous; the breast reddish brown, with black spots; no zigzag markings on the flanks; rump and lower tail-coverts greyish.

1960.—THE MALLARD

(*Anas Boschas*), Bill of. Boschas major, Brisson; Canard sauvage of the French; Capo Verde (male), Anitra (female), Germano, and Paperone of the Italians; Wilde Ente of the Germans; Cors Hwyad, Garan Hwyad, and Hydnwy of the ancient Britons. This species is the origin of our domestic duck, and is spread over the northern and temperate portions of Europe, Asia, and America. It is everywhere a migratory bird: and though it breeds abundantly in our island and the adjacent parts of the Continent, yet the great rendezvous of the species is in the higher latitudes, whence, on the approach of winter, vast flocks wing their way southwards, visiting marshes, lakes, and rivers, and returning northwards early in spring. Though the domestic duck is polygamous, the wild birds pair, but do not mutually assist each other in the work of incubation or care of the brood, for when the female begins to sit, the male deserts her and joins others of his sex, so that it is not unusual after May to see the males (or mallards) in small companies by themselves.

As is the case with the teal, wigeon, pintail duck, &c., the plumage of the male, towards the middle of summer, undergoes a remarkable change, and approaches in colouring to that of the female; not, as it would seem by a moult of the feathers, but by an actual change of tint. With the autumn moult, the drake regains his beautiful dress. In the tame drake this alteration is not so definite.

The female makes her nest in some dry spot in the marshes, not far from the water, and in the covert of dense tall herbage and bushes. It is composed of withered grass and other vegetables; the eggs are from ten to fourteen in number, of a bluish white. When the female quits the nest for food, she covers the eggs with down and other substances. Though the female wild duck generally breeds in the marshes as stated, she occasionally chooses very different situations, and several instances have been recorded in which the eggs have been deposited on the fork of a large tree or in some deserted nest. Mr. Selby informs us that an instance of this kind came under his personal observation near his own residence; the bird having laid her eggs in the old nest of a crow, at least thirty feet from the ground, and hatched her young; "and as none were found dead under the tree, it is presumed that she carried them safely to the ground in her bill, a mode of conveyance known to be frequently adopted by the eider-duck." Montagu says, "We have been assured by a person of undoubted veracity, that a half-domesticated duck made a nest in Rumford Tower, hatched her young and brought them down in safety to a piece of water at a considerable distance. Others have been known to breed in trees; and we recollect the nest of this bird being found in the head of an old pollard willow impending the water, whence the young might readily drop unhurt into their natural element. Mr. Etchington mentions one in Sussex which was found sitting upon nine eggs on an oak-tree twenty-five feet from the ground; and the author of the 'Rural Sports' records an instance of one taking possession of the nest of a hawk in a large oak. To these we can add, upon the testimony of a gentleman of the strictest veracity, that out of a large flock of half-domesticated ducks, one deposited her eggs in the principal fork of a large tree near his house."

In the drake, or male, the trachea is furnished at its lower larynx with an osseous bulla of considerable magnitude.

In all countries the domestic duck is valued for the sake of its flesh, of the excellency of which nothing need be said. In China, where these birds are kept in vast numbers, housed at night in boats on the river, thousands are hatched by artificial means; the eggs are placed in tiers or boxes filled with sand, and subjected to the necessary degree of heat upon a floor of bricks. "The ducklings are fed at first with a mess composed of boiled crawfish or crabs, cut in small pieces and mixed with rice. In about a fortnight they are able to shift for themselves, when they are placed under the guidance of an old stepmother, who leads them at stated times to feed, to and from the boat in which they are kept, and which is moved about by the owner to places likely to afford a plentiful supply of food."

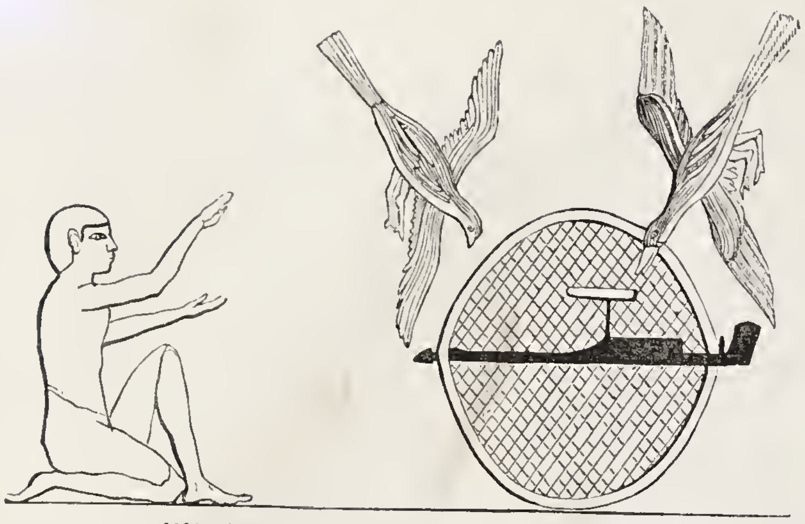
It is curious to see how well a flock of three or four hundred ducks are trained to obey their master, for some thousands belonging to different boats will feed at large on the same spot, and, on a signal given, follow their leader to their respective boats without a stranger being found amongst them.

Wild ducks were formerly much more abundant in our island than at present, in consequence of the drainage of our marshes. Pennant records that during one season in the neighbourhood of Wainfleet, of ducks, wigeons, and teals 31,200 were taken in only ten decoys, of which more than two-thirds were of the present species; and that at a single driving of the fens in Lincolnshire, before the young had taken wing, and while the old birds were in moult, one hundred and fifty dozens have been captured. The same district at the present time scarcely produces a dozen broods in the year.

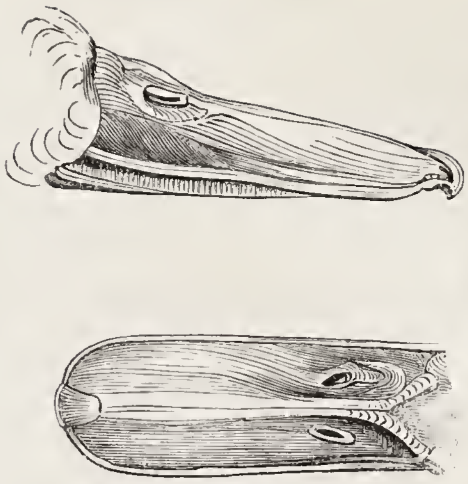
The mode of capturing wild ducks varies in different countries; at the Lakes of Peronne in Picardy the fowlers, concealed in huts of reeds, scatter destruction amidst the flocks by the gun, as is well detailed by Colonel Hawker. In China the sportsman covers his head with a calabash, and wading up to his neck, mixes with the flock, and seizing his victims by the feet, pulls them under the water, kills them, and fastens them to his girdle without exciting any alarm among the survivors.

Figs. 1961 and 1962 are illustrative of the decoy plan adopted in the fens of Lincolnshire.

In the lake to which the wild ducks resort, their most favourite haunts are observed. Then in the most sequestered part of this haunt a ditch is cut, which is about four yards across at the entrance, and decreases gradually in width from the entrance to the farther end, which is not more than two feet wide. The ditch is of a circular form, but does not bend much for the first ten yards. The banks of the lake on each side of this ditch (or "pipe," as it is called) are kept clear from reeds, coarse herbage, &c., in order that the fowl may get on them to sit and dress themselves. Along the ditch, poles are driven into the ground, close to its edge, on each side, and the tops are bent over across the ditch and tied together. These poles, thus bent, form at the entrance of the ditch or pipe an arch, the top of which is ten feet distant from the surface of the water. This arch is made to decrease in height as the pipe decreases in width, so that the remote end is not more than eighteen inches in height. The poles are placed about six feet from each other, and connected by poles laid lengthwise across the arch and tied together. Over the whole is thrown a net, which is made fast to a reed-fence at the entrance and nine or ten yards up the ditch, and afterwards strongly pegged to the ground. At the end of the pipe farthest from the entrance is fixed a "tunnel-net," as it is called, about four yards in length, of a round form, and kept open by a number of hoops, about eighteen inches in diameter, placed at a small distance from each other to keep it distended. Supposing the circular bend of the pipe to be to the right when one stands with his back to the lake, then on the left-hand side a number of reed-fences are constructed, called "shootings," for the purpose of screening the "decoy-man" from observation, and in such a manner, that the fowl in the decoy may not be alarmed while he is driving those that are in the pipe. These shootings, which are ten in number, are about four yards in length, and about six feet high. From the end of the last shooting a person cannot see the lake, owing to the bend of the pipes, and there is then no further occasion for shelter. Were it not for these shootings, the fowl that remain about the mouth of the pipe would be alarmed if the person driving the fowl already under the net should be exposed, and would become so shy as entirely to forsake the place. The first thing that the decoy-man does when he approaches the pipe is to take a piece of lighted turf, or peat, and hold it near his mouth, to prevent the birds from smelling him. He is attended by a dog, trained for the purpose of rendering him assistance. He walks very silently about half-way up the shootings, where a small piece of wood is thrust through the reed-fence, which makes an aperture just large enough to enable him to see if any fowl are in; if not, he walks forward to see if any are about the entrance of the pipe. If there are, he stops and makes a motion to his dog, and gives him a piece of cheese, or something else, to eat; and, having received this, the animal goes directly to a hole through the reed-fence, and the birds immediately fly off the bank into the water. The dog returns along the bank between the reed-fences, and comes out to his master at another hole. The man then gives him something to reward and encourage him, and the animal repeats his round until the birds are attracted by his motions, and follow him into the mouth of the pipe. This operation is called "working" them. The man now retreats farther back, working the dog at different holes until the ducks are sufficiently under the net. He then commands his dog to lie down behind the fence, and going himself forward to the end of the pipe next the lake, he takes off his hat and gives it a wave between the shootings. All the birds that are under the net can then see him; but none that are in the lake can. The former fly forward, and the man then runs to the next shooting and waves his hat, and so on, driving them along until they come to the tunnel-net, into which they creep. When they are all in, the man gives the net a twist, so as to prevent them from getting back. He then takes the net off from the end of the pipe, and taking out, one by one, the ducks that are in it, dislocates their necks. This is the scene represented in Fig. 1962. The net is afterwards hung on again for the repetition of the process; and in this manner five or six dozen have sometimes been taken at one drift. When the wind blows directly in or out of the pipes, the fowl seldom work well, especially when it blows into the pipe. The reason of this is, that the ducks always prefer swimming against the wind, otherwise the wind blowing from behind catches and ruffles their feathers. If many pipes are made in the same lake, they are so constructed as to suit different winds, and are worked accordingly. The better to entice the fowl into the pipe, hemp-seed is occasionally strewn on the water. The season allowed by Act of Parliament for taking ducks in

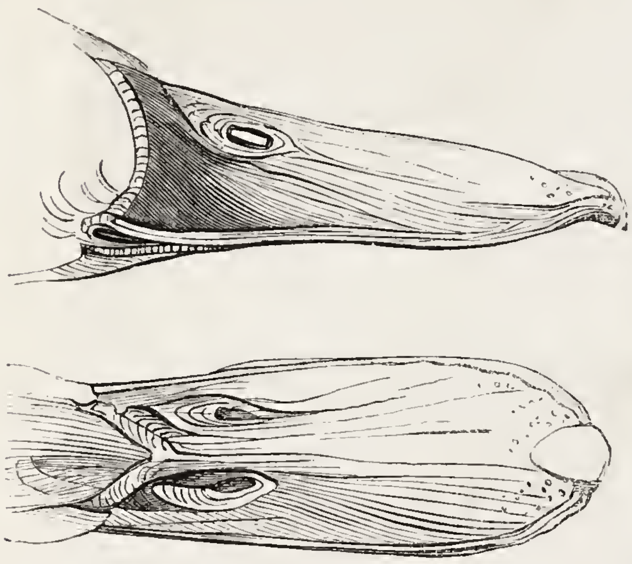


1964.—Clap-net of Ancient Egyptians for Bird-catching.



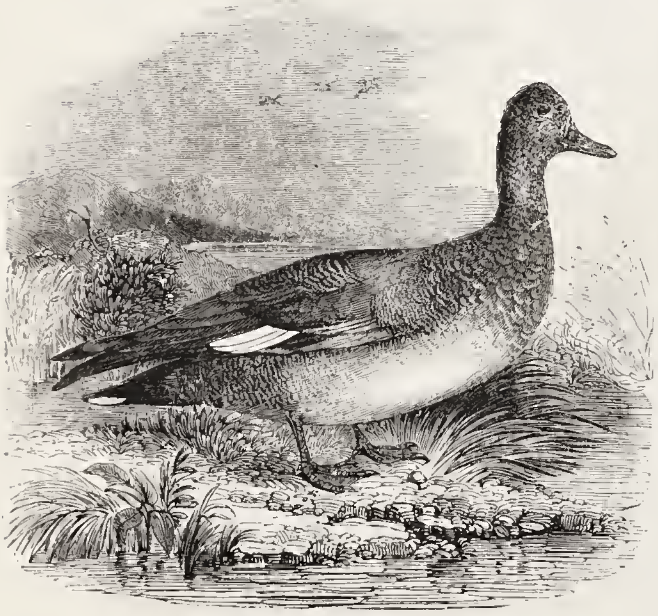
1959.—Bill of Gadwall.

1955.—Shoveller.



1960.—Bill of Mallard.

1961.—Wild-Duck Decoy, Lincolnshire.



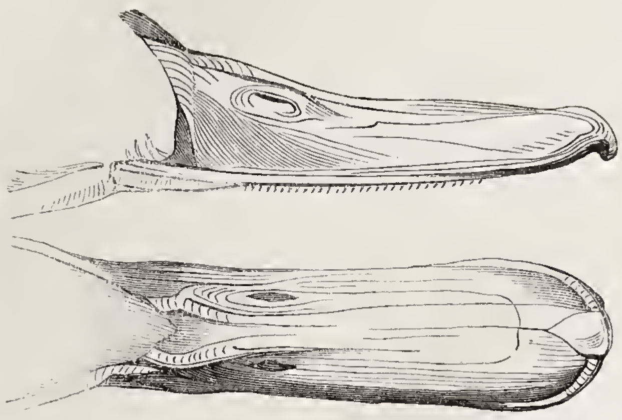
1958.—Gadwall.

1956.—Bill of Shoveller.

1963.—Ancient Egyptians Bird-catching in the Marshes.

1957.—Bill of Malacorhynchus.

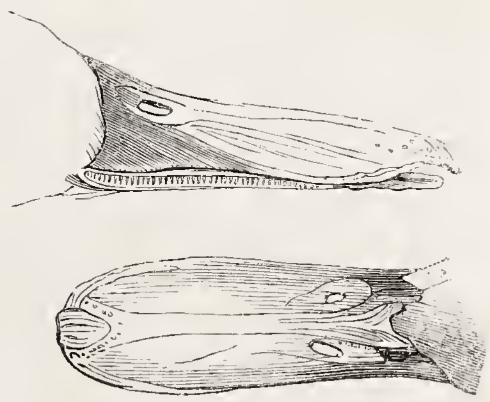
1967.—Common Teals.



1969.—Bill of Pintailed Duck.

1968.—Pintailed Duck.

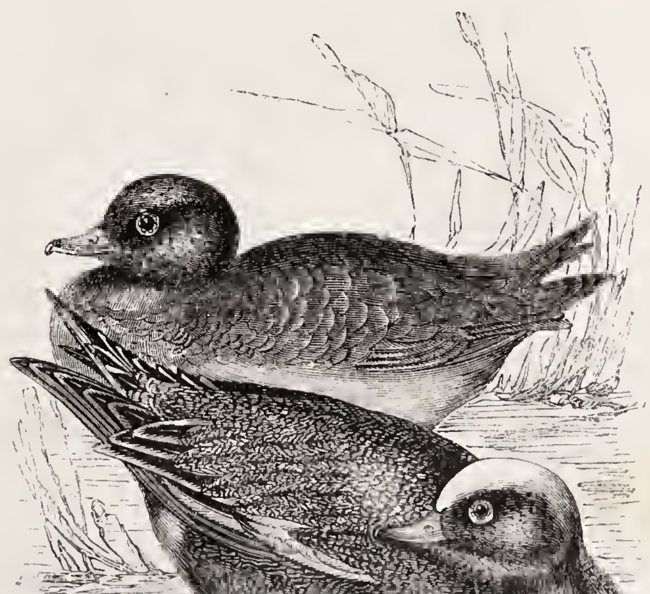
1962.—Wild Duck Decoy, Lincolnshire.



1966.—Bill of Blue-winged Teal.

1965.—Blue-winged Teal.

1970.—Head and Foot of Sheldrake.



1971.—Widgeons.

this way is from the latter end of October until February.

Willughby states that formerly before the young ducks took flight, or while the old ones were in moult and unable to fly, they were driven by men in boats furnished with long poles, with which they splashed the water, between long nets stretched vertically across the pools in the shape of two sides of a triangle, into lesser nets placed at the point, and in this way he says that four thousand were taken at one drive in Deeping Fen; and Latham has recorded an instance in which two thousand six hundred and forty-six were taken in two days near Spalding, in Lincolnshire; but these practices being considered injurious, were prohibited by statute in the reign of George II.

Fig. 1963 is the copy of an Egyptian painting, in the British Museum, representing a fowler in a boat on the marshes or flooded grounds, evidently engaged in the capture of wild-fowl, apparently by the decoy plan, in which he is assisted by trained birds, and, strange to say, by a cat, which is delineated in the act of seizing a bird, while holding down another which she has already caught. As the picture is only a fragment, a complete detailed explanation is not to be deduced from it.

Fig1. 9 64 represents an Egyptian attending to a baited clap-net, into which a brace of wild ducks are winging their way, and which is doubtless so constructed as to enclose them when they alight. These relics of antiquity are interesting, as affording an insight not only into the habits and practices of a people of remote ages, but also into the zoological productions of their country, and thereby enabling us to compare them with those of the present day. We may observe, *en passant*, that the Egyptians represented birds and mammalia with singular fidelity, in comparison with their delineations of the human figure.

1965.—The Blue-Winged Teal

(*Cyanopterus discors*, Eyton). Anas discors, Linn. This species is a native of the northern regions of America, and in eastern Europe and Asia is represented by a distinct species (C. Circia, Eyton; Anas Querquedula, Linn.).

The blue-winged teal appears in September along the shores of the Delaware in crowded flocks, which sit on the mud close to the water's edge, so that many are killed by the gunner at a single discharge. Their flesh is excellent, as they feed chiefly on the seeds of reeds or wild oats, and after a short residence in favourable localities become very fat. When the frost begins to set in, they proceed southwards, being very susceptible of cold. They abound during the winter in the inundated rice-fields of the Southern States, where, as Wilson informs us, vast numbers are taken in traps placed on small dry eminences that here and there rise above the water. These places are strewed with rice, and the birds are caught alive. In the month of April flocks of the blue-winged teal pass through Pennsylvania for the north, but make little stay at that season.

In the male the forehead and top of the head are black; a large crescent of white extends on each side from the eye to the throat; the rest of the head and half the neck dark slate-colour, richly glossed with green and violet: remainder of the neck and breast dusky black thickly marked with semicircles of brownish white intersecting each other; under parts pale brown, barred with narrow dusky lines; the sides spotted with oval dusky marks; the flanks waved with large semicircles of pale brown; under tail-coverts black; back deep brownish black, each feather waved with brownish white; lesser wing-coverts bright light blue; primaries brown; secondaries black; speculum rich green; tertials edged with black or light blue, and streaked down the middle with white; feet yellow; bill dark slate-colour. Length fourteen inches. In the female the head and neck are of a dull dusky slate-colour; the hind head whitish; and the general colouring is less pure and definite.

Fig. 1966 represents the Bill of the blue-winged Teal, which approaches in form to that of the mallard.

1967.—The Common Teal

(*Querquedula Crecca*). Sarcelle, Petite Sarcelle, Cercelle, Cercerelle of the French; Cercedula, Cercevolo, Scavolo. Sartella, and Anitrella of the Italians; Spiegel Entlein and Kriekente of the Germans; Cor Hwyad and Brach Hwyad of the ancient British.

This beautiful little duck, which is too well known to require a detailed description, is widely spread over Europe and Asia. It is found in India, China, and Japan: it visits North Africa; and is common in Germany, Holland, France, and Italy. It breeds in Norway, Sweden, Lapland, and Iceland, nor must the British Islands be excluded, for although there are flocks of these birds which arrive in our marshes from the north about the end of September, and return thither again in spring, still we have our own indigenous birds, which continue permanent, breeding and rearing their broods. Cumberland, Northumberland, Norfolk, the borders of some of the lakes in Wales, are known to afford suitable localities, which they regularly tenant; a few breed in Romney Marsh; in Ireland some are also resident throughout the year. The nest of this species is formed of decaying vegetable matters, with a lining of down and feathers; it is placed amidst the long rushy herbage about the edges of lakes, or in the boggy parts of the upland moors. The eggs, from eight to ten or twelve in number, are of a cream white.

The flight of the teal is wonderfully rapid, and when the bird is flushed the sportsman must be on the alert, otherwise it will be beyond range of shot ere he draws his trigger. Night is the feeding-time of this species; during the day it reposes upon the water, or sits shrouded amidst the herbage of the bank with the head couched between the shoulders, or with the bill under the scapulars: immediately after sunset it wings its way to its usual feeding-ground; aquatic plants and their seeds, grain, fresh-water mollusks, insects and their larvæ, constitute its diet. For the sake of its beauty the teal is often kept on ornamental sheets of water, and becomes very tame and familiar; those in the Zoological Gardens have for several years past bred annually. Of all our water-fowl this is the most delicate for the table, and, as Willughby remarks, "doth deservedly challenge the first place among those of its kind." Accordingly we find it recorded among the abundance of good things composing the lordly banquets of the olden time.

1968.—The Pintailed Duck

(*Dafila caudacuta*). Anas Caudacuta, Ray; Anas acuta, Linn.; Anas longicauda, Brisson; Querquedula acuta, Selby; le Canard à longue queue ou Pilet of the French; Anitra codilanza and Anitra di coda lunga of the Italians; Speissente and Fasanente of the Germans; Hwyad gynffonfain of the ancient British.

Fig. 1969 represents the Bill of the Pintailed Duck, in which the laminæ are only moderately developed, while the elevation at the base exceeds the breadth. The bulla of the windpipe is of the size of a small hazel-nut. The pintailed duck is a native of the northern parts of Europe, Asia, and America, breeding in the high latitudes, whence on the approach of winter it wings its way southwards, to return again in spring. It visits Holland, France, and Germany in great numbers, as well as the British Islands, the fens of Lincolnshire, Norfolk, &c. being its principal places of resort. It is a shy and wary bird, and one of the first to give the alarm on the approach of the gunner. Contrary to the statement of Montagu, Mr. Selby asserts, from long personal observation, that it is of rare occurrence in the north of England and the south of Scotland, and that he has reason to believe that in the north of Scotland and the adjacent islands it is equally uncommon, the long-tailed duck (Harelda glacialis), which in winter frequents the bays of the Orkneys and other groups of islands in great abundance, having been mistaken for it.

This species is easily domesticated, but seldom breeds in confinement; yet hybrids between it and other ducks have occasionally been produced.

Mr. Selby observes that the season of courtship is indicated by the male suddenly raising himself upright in the water, and bringing his bill close to his breast, at the same time uttering a low soft note; this gesticulation being often followed by a jerk of the hinder part of the body, which is then also thrown above the water. We may add that somewhat similar gesticulations are common to the mallard and other species.

The pintailed duck is a bird of graceful proportions, with a slender neck and elongated tail, and, as is the ease with the mallard and several others, as the teal and wigeon, the plumage of the male after the breeding-season undergoes a remarkable change of colour, and assimilates to that of the female.

In the male, in full plumage, the head and throat are dark hair brown, the lower part of the neck, and two streaks running up to the hind part of the head, the breast, and under parts, white. Back of the neck deep brown. Flanks and thighs with fine transverse black lines. Under tail-coverts velvet black. Back marked with alternate wavy lines of black and greyish white. Scapulars black; tertials long, acuminate, and black, with yellowish white margins. Lesser wing-coverts deep smoke-grey. Speculum blackish green, with a bronzed reflexion, bordered below by white. Quills brown. Two middle tail-feathers elongated, acuminate, and black, the rest brown margined with white. Bill black. Legs blackish grey.

1970.—The Sheldrake

(*Tadorna Vulpanser*), Head and Foot. Anas Tadorna, Linn.; la Tadorne, Buffon; Brandente Bechstein; Volpoca of Savi; Hwyad yr eithin and Hwyad fruith of the ancient British.

The Sheldrake is a native of northern Europe and Asia, and occurs in Japan. We may enumerate it among the indigenous birds of our islands, as it breeds with us, and may be seen at all seasons upon various parts of the coast, and on the mud-banks of our tidal rivers, but rarely far inland; their numbers however are greatly increased in the winter by accessions from the north, which return to their summer haunts in March. This species selects rabbit-warrens along the coast as its breeding-place, and taking up a deserted burrow, there makes a nest of dried grass, lined with soft down plucked from its own breast. The nest is sometimes ten or twelve feet from the entrance; but where there are no burrows accessible, it is placed in a fissure of the rock or bank: the eggs are ten or twelve in number, and of a pure white. The parents are very solicitous respecting their young. During the period of incubation (thirty days) the male keeps watch, and takes the place of the female when she leaves the nest for food. When the young are hatched, they are conducted or carried in the bill of their parents to the sea, where they swim about in some sheltered spot, seldom leaving the water till fully fledged. When the nest or young are in danger, the old birds show great address in decoying the intruder to a distance, feigning lameness, and fluttering along the ground before him; hence the natives of the Orkneys call this bird the sly goose. The food of the present species consists of seaweed, shelled mollusks, small crustacea, the spawn and fry of fishes, and also grain. The flesh is rank and bad. From its great beauty the sheldrake is often kept tame as an ornamental appendage to lakes and sheets of water in parks or gardens, and numbers of the young are annually captured for sale. Selby states that in confinement this species seldom breeds; one instance came under his own observation, and another is recorded by Montagu. We may here observe that the sheldrake has bred both in the gardens of the Horticultural Society and in those of the Zoological Society.

The sheldrake is distinguished from the ducks of other genera by the form of its bill, which is comparatively short, high at the base, depressed in the middle, with the tip flattened and turning upwards, and the nail abruptly curved. The legs are long, and placed in the centre of the body, whence the birds run on shore with considerable ease and quickness. There is a fleshy knot on the base of the upper mandible in the male, which increases on the approach of the pairing-season, and acquires a beautiful crimson hue. The trachea of the male is furnished at the lower larynx with two thin bullæ, of which that on the right side is the largest. The head and neck are greenish black; the lower part of the neck, wing-coverts, back, sides, rump, and base of tail, pure white. Scapulars, a large band girding the middle of the belly, quills and extremity of caudal feathers deep black; a large bay-coloured gorget adorns the breast. Speculum, or beauty-spot of the wings, purple green. Feet flesh-coloured. The female is less than the male, and her colours are more obscure.

1971.—The Wigeon, or Widgeon

(*Mareca Penelope*). Canard Siffleur of the French; Anistra fischiarola, Anatra marigiana, and Fischione of the Italians; Pfeifente of the Germans; Chwiw of the ancient British.

The Wigeon is a native of the northern regions of Europe and Asia, breeding in Lapland, Sweden, Norway, &c., whence on the approach of winter vast flocks wing their way southwards, visiting Holland, Germany, France, Spain, and Italy. It occurs in the neighbourhood of the Caucasus, in India, and Japan. In the British Islands it arrives about the beginning of October, visiting our inland marshes, bays, and the mouths of rivers, and great numbers are annually taken in decoys, for the sake of the flesh, which is very excellent, as a vegetable diet (aquatic plants, sea-weeds, and ordinary grass) forms the chief support of this species. Dr. Richardson in a note gives the following interesting particulars, which he derived from Skelton, the intelligent keeper of a decoy in Lincolnshire:—"With respect to food, the mallard, pintail, and teal frequent rich flooded lands, *swittering* with their *nebs* in the soil, and sucking out all its *strength*, but the wigeon feeds quite differently, *being an amazing fowl to graze and a strange eater of grass*. It is especially fond of flutter grass (glyceria), which it crops on the surface, but it likewise eats many other herbs." It is partial to willow-weed seeds (epilobium), as are also the mallard, teal, and pintail, preferring them to oats; and it feeds by day, but is also nocturnal in its habits. The wigeon has been known to breed in Sutherlandshire; the nest is placed among low bushes, reeds, or rushes near fresh water, and is composed of vegetable materials

in a state of decay, lined with warm down plucked from the parent's body. The eggs are cream coloured. The flocks of this species, while on the wing, utter during their flight a peculiar whistling call-note, by which the fowler, during the night, easily distinguishes them. From this call the bird in some places has received the name of Whew-duck. Early in March the flocks begin their polar migration, and by the month of April our morasses and shores are deserted. The wigeon is too well known to need a detailed description. Fig. 1971* represents the Bill of this species.

1972.—THE AMERICAN WIGEON

(*Mareca Americana*). This species, which breeds in the high northern latitudes of America, is common in winter in the United States, and particularly so in Carolina, where it frequents the plantations of rice. It visits Guiana and St. Domingo. According to Wilson, the American wigeon is extremely fond of the tender roots of that particular species of aquatic plant on which the Canvas-back Duck, so abundant in Chesapeak Bay, habitually feeds; hence the wigeon, as it never dives, is the constant attendant of the canvas-back, and is always on the watch for its rising from the deep with the tempting morsel in its bill, which the wigeon immediately snatches away. On this account the canvas-back and wigeons, or, as they are called round the bay, Baldpates, live in a state of perpetual contention.

As is the case with our European species, the present is remarkable for its whistling call as it wings its way by night, and this call is frequently imitated as a means of enticing the birds within gun-shot.

1973, 1974.—THE SUMMER DUCK

(*Dendronessa Sponsa*). The Wood-duck of Audubon.

This beautiful species is extensively spread over the whole of the United States of America, and is equally common in Mexico and several of the West India Islands. Its favourite haunts are secluded sheets of water embosomed in the woods, mill-dams, and ponds, the shore of the sea being seldom or never visited. In the warmer latitudes it is a permanent resident, but in the more northern districts is a bird of passage, retreating southwards as winter comes on, and returning in the spring. In the Middle States the Summer duck breeds about the beginning of April; in the Northern States, seldom before the early part of June; while in the Southern States it pairs about the first of March, or a week earlier. Unlike the duck tribe generally, this species never makes a nest on the ground, but chooses the deep hole which the great ivory-billed woodpecker has made in a tree, or the deserted retreat of some squirrel, or the hollow left by the breaking off of some large limb; the tree chosen usually overhangs the water or swamp, or is at no great distance from it. The nest is composed of feathers and dried herbage, with a little down, the latter mostly plucked from the breast of the female. The eggs vary from six to fifteen in number, and are smooth, polished, and of a colour between buff and pale green. As is the case with our wild duck, the male deserts the female when she commences the task of incubation, and joins with others of his own sex, forming flocks, which in the autumn are augmented by the females and young of the year, all keeping together till the spring pairing-time. When the breeding-place overhangs the water, the young ducks, soon after being hatched, scramble to the mouth of the hole, and, spreading their little wings and feet, drop into their favourite element, where the female diligently attends them: if, however, the tree should be at some distance from the water, the female carries them to it one by one in her bill, holding them so as not to injure their yet tender frame. The same retreat is occupied year after year by the same pair, and instances have been known of their frequenting a favourite tree after the colonist had occupied the land around it, and the noise of the saw and the hammer, and the voices of busy workmen, resounded at its foot; yet the Summer duck is naturally a shy bird, and usually avoids the presence of man, whom it has learned to fear. The food of this species consists of acorns, grain, the seeds of plants, insects, &c.

In captivity the Summer duck is very tame, and, we doubt not, might be easily naturalized as a domestic tenant of our homesteads. It breeds freely in the Zoological Gardens. As an ornament to our sheets of water it has no superior.

The colouring of the male is as follows:—Head above and space between the eye and bill glossy dark green; cheeks and a large patch on the sides of the throat purple, with blue reflexions; pendent occipital crest of green and auricula purple, marked with two narrow white lines, one of them terminating behind the eye, the other extending over the eye to the bill; sides of the neck purplish red, changing on the front of the neck and sides of the breast to brown, and there spotted with white. Scapulars, wings, and tail exhibiting a play of duck green, purple, blue, and velvet black colours; interscapulars, posterior part of the back, rump, and upper tail-coverts blackish green and purple; several of the lateral coverts reddish orange; a hair-like, splendent, reddish purple tuft on each side of the rump; the under coverts brown. Chin, throat, a collar round the neck, a crescentic bar on the ears, the middle of the breast, and whole of the abdomen white. Flanks yellowish grey, finely undulated with black; the tips of the long feathers and also those on the shoulder broadly barred with white and black. Inner wing-coverts white, barred with brown. Almost all the coloured plumage shows a play of colours with metallic lustre. Bill red; a space between the nostrils, its tip, margins, and lower mandible black. Legs orange-coloured. Length nineteen inches.

The plumage of the female is much plainer than that of her mate, being chiefly coloured with drab and glossy brown, the fine pencillings of the sides being wanting. Fig. 1975 represents the Bill of the Summer Duck.

1976.—THE MANDARIN DUCK

(*Dendronessa galericulata*). Een-Yeong of the Chinese, according to Mr. G. Bennett.

Like the Summer duck of America, this is an arboreal bird, roosting in high trees. It is a native of China, and is often seen well represented in Chinese paintings. The Mandarin duck appears to mate for life; at all events, these birds are regarded by the Chinese as emblems of conjugal fidelity, and are usually carried about in their marriage processions.

The male is extremely beautiful, and remarkable for the long silky feathers of the head and neck, and the broad feathers which rise vertically from the wings. During four months of the year, however, that is, from May to August, the male changes his splendid dress, and bears a close resemblance to the unadorned female.

This species has bred in the Zoological Gardens, and, like its congener the Summer duck, might doubtless be naturalized.

We shall now pass to the marine or diving ducks, which live almost exclusively in the sea, and dive deep for their food. The plumage is close and thick; the limbs placed far back; the neck is thick and short; the wings short; and diving, rather than flight, is resorted to as a security from danger.

1977, 1978, 1979.—THE EIDER-DUCK

(*Somateria mollissima*). Oie à duvet, ou Eider of the French; Eiterente of the Germans; Hwyad fwythblu of the ancient British; St. Cuthbert's Duck, Great black-and-white-Duck, Dunton Duck, &c. Fig. 1978, the Female.

In the genus Somateria the bill is small, with the base elevated, and extending up the forehead, where a central narrow line of feathers divides it. Apex narrow; sides with coarse wide laminations; nostrils small, oval; hind-toe with a lobated membrane. Fig. 1980 represents the Bill of the Eider-duck.

It is from this bird, and an allied species, the King-Eider, that the down so celebrated for warmth and lightness is procured. The eider-duck is oceanic in its habits, tenanting the northern seas, and is very abundant on the shores of Iceland, Greenland, Lapland, Spitzbergen, and those of Baffin's and Hudson's Bays. It is called Mittek by the Greenlanders. It is only an accidental visitor to our southern coasts, but is common in the Hebrides, where it annually breeds, as also on the Farn Islands on the Northumbrian coast. In Iceland and Norway the districts to which this bird resorts are regarded as valuable property, and strictly preserved; but in Labrador, where the eider is abundant, the egg-gatherers kill it in great numbers, for mere wantonness, but neglect the down. The Greenlanders chase the eider for the sake both of the flesh and skin; and also rob the nests of the down and the eggs, the latter being esteemed excellent food. It is the down with which the female lines her nest that is so valuable; that taken from the dead bird being of very inferior quality. The mode in which the down is collected in Iceland and Norway, where every one is anxious to have an eider-estate, is as follows:—The female is suffered to lay her five or six eggs, which are placed in a nest constructed of marine plants, with the warm elastic material in question as a lining: these eggs and the down are taken; she then relines her nest, and lays a second time: the eggs and down are again abstracted. Unable to supply more down, the male now strips his breast, and furnishes a supply, known by its pale colour; on this the female lays two or three eggs, which she is suffered to hatch unmolested, for were these to be taken the bereaved bird would utterly forsake the inhospitable place, and return no more. The quantity afforded by a single female is, when cleaned, about half a pound.

The eider-duck is a bird of recluse habits, disliking interruption, though not particularly timid. Hence it generally chooses for its breeding-haunt low flat islands along the coast, and narrow slips of land projecting into the sea: here multitudes assemble during the summer, in order to rear their broods, and are at that time very tame.

Sir George Mackenzie, during his travels in Iceland, had an opportunity, on the 8th June, at Vidöe, of observing the eider-ducks, at all other times of the year perfectly wild, assembled for the great work of incubation. The boat, in its approach to the shore, passed multitudes of these birds, which hardly moved out of the way; and, between the landing-place and the governor's house, it required some caution to avoid treading on the nests, while the drakes were walking about, even more familiar than common ducks, and uttering a sound which was like the cooing of doves. The ducks were sitting on their nests all round the house, on the garden wall, on the roofs, nay even in the inside of the houses and in the chapel. Those which had not been long on the nest generally left it when they were approached; but those that had more than one or two eggs sat perfectly quiet and suffered the party to touch them, though they sometimes gently repelled the intrusive hand with their bills. But, if a drake happen to be near his mate when thus visited, he becomes extremely agitated. He passes to and fro between her and the suspicious object, raising his head and cooing.

The food of the eider-duck consists of small crustacea, mussels, and other shell-fish, and various marine animals, in quest of which it dives with great address. The male and female differ greatly in colouring. In the male, on each side of the head and above the eyes, is a large band of black feathers; the sides of the throat and back of the neck are of a delicate sea-green; the neck is white, with a tinge of yellow passing into buff on the breast; back and shoulders white; quill-feathers, tail, and under parts black. The female has the plumage universally of a brownish red, barred transversely with black; bill oil-green; legs greenish yellow.

1981.—THE SURF-DUCK

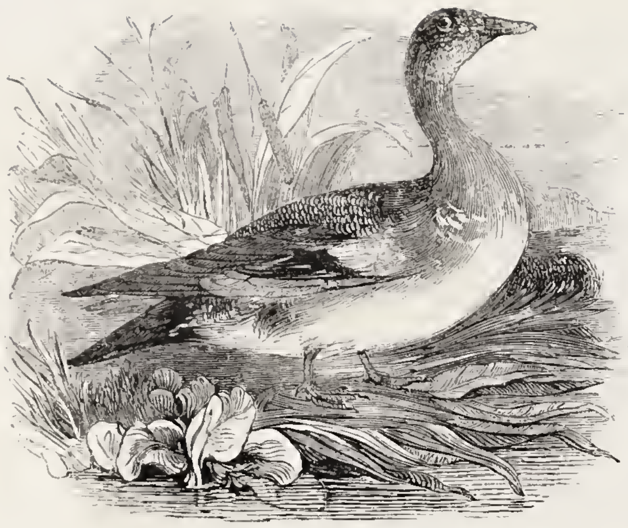
(*Oidemia perspicillata*). Surf-Scoter, Black Duck, of Edwards; Macreuse à large bec ou Canard Marchand of the French.

In the genus Oidemia the bill is broad, with dilated margins and coarse lamelliform teeth; it rises abruptly above the nostrils; the forehead encroaches in a point on the upper mandible. Fig. 1982 represents the Bill of the Surf-Duck.

This species is common and abundant at Hudson's and Baffin's Bays, and may be regarded rather as an American than a European species, its visits to the Orkneys and the European seas being merely accidental. It was seen at Nootka Sound by Captain Cook. The Prince of Canino notes it as very abundant in the sea in the neighbourhood of the shore at Philadelphia. During the summer the surf-duck haunts shallow estuaries, bays, and bars, where it feeds upon shell-fish, and dives with remarkable vigour in the midst of the heavy surf. It breeds, among other places, on the shores of Hudson's Bay, and in Labrador, making a nest of grass, and lining it with down. The eggs are four or five in number, of a white colour.

The winter migrations of this species extend to Florida, but numbers remain during the cold season along the shores and in the open bays of the United States. The northward return takes place early in May. The male is velvet black, with a reddish reflexion; throat brownish; a broad white band between the eyes, and a triangular patch of the same on the nape; bill reddish orange, the nail paler; a square black spot on the lateral protuberance; legs orange; webs brown; bill much like that of the Velvet Scoter (Oidemia fusca), but the lateral protuberances are naked and horny, and the central one is feathered farther down. The laminæ are distant, and the lower ones particularly prominent, with cutting edges. As in the other Oidemiæ, the bill and forehead are inflated, causing the head to appear lengthened and the crown depressed. The nostrils are rather large, and nearer to the point than to the rictus. Length twenty-four inches. (Dr. Richardson, from a bird killed at Fort Franklin.)

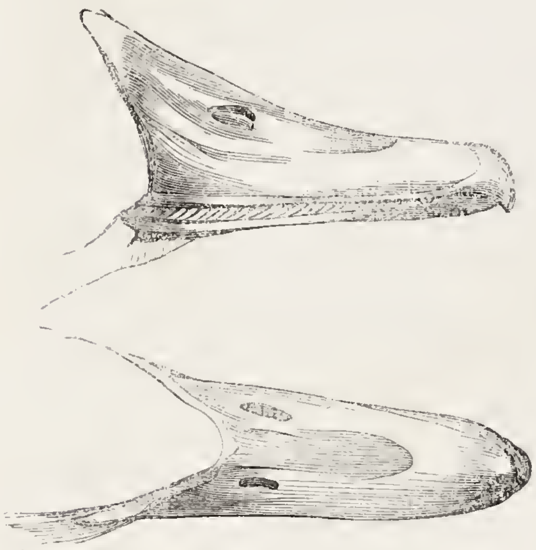
Female and Young:—Black ashy brown wherever the male is deep black. Head and neck lighter; frontal band and great angular space upon the nape indicated by very bright ashy brown. Lateral protuberances of the bill but little developed, and the whole bill of an ashy yellowish colour. Feet and toes brown; webs black. (Temminck.) Dr. Richardson observes that the under plumage in particular is paler; that the back and wing-coverts are narrowly edged with grey; that the breast, flanks, and ears have some whitish edgings; that the bill is black, its base not so much inflated; and that the nostrils are smaller than in the male.



1972.—American Widgeon.

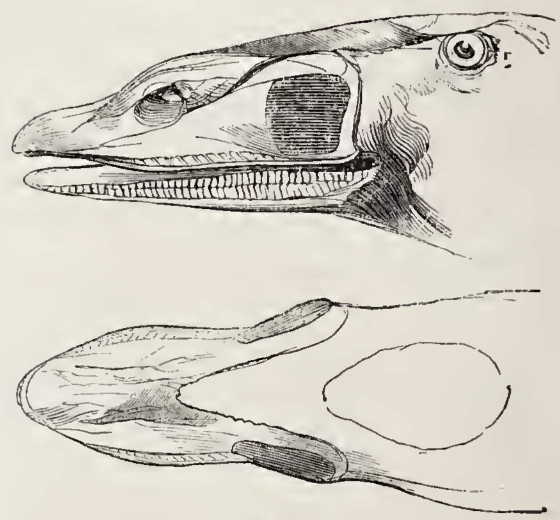
1973.—Summer Duck.

1976.—Mandarin Duck.

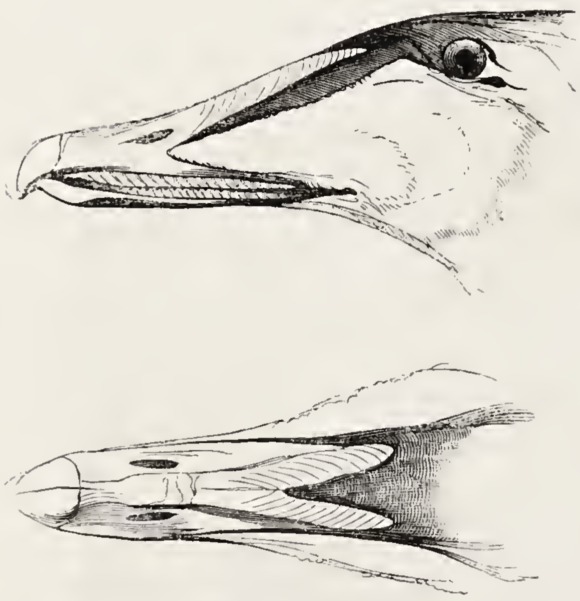


1975.—Bill of Summer Duck.

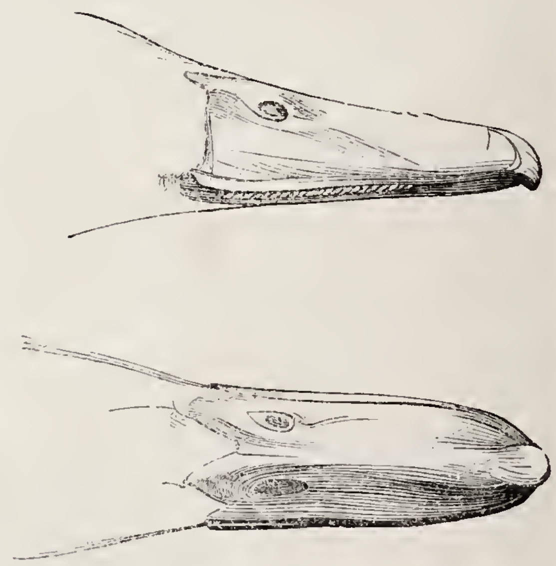
1974.—Summer Duck.



1982.—Bill of Surf Duck.

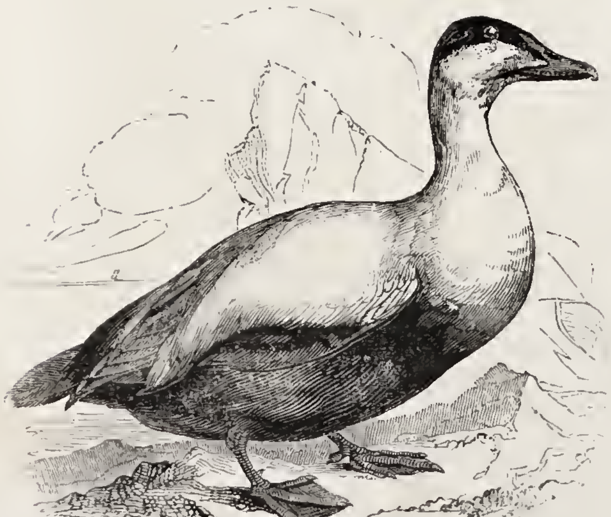


1980.—Bill of Eider-Duck.

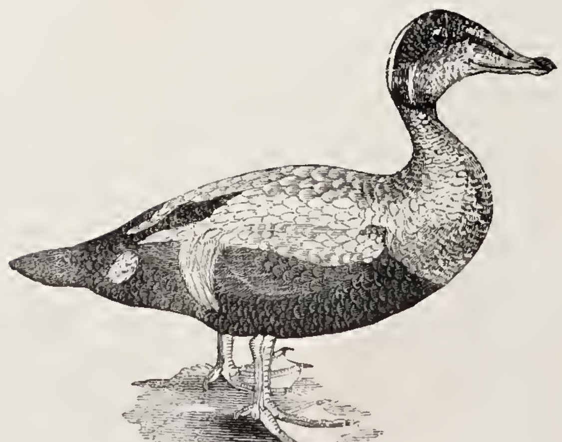


1971.*—Bill of Widgeon.

1978.—Female Eider-Duck.



1977.—Male Eider-Duck.



1979.—Eider-Duck.

1981.—Surf-Duck.

1984.—Beak of Canvas-back Duck.

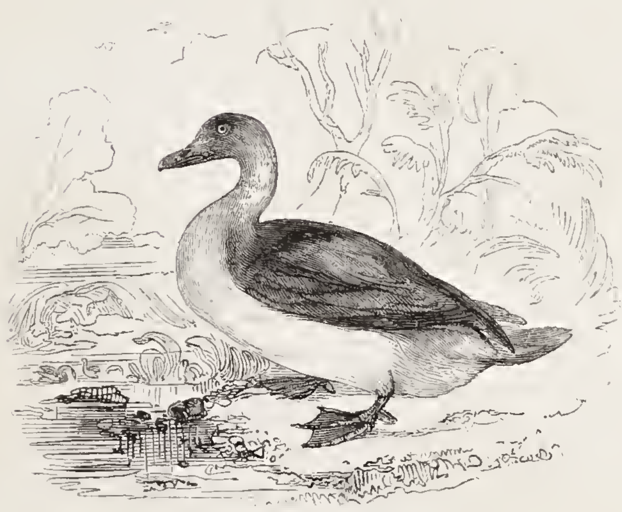
1987.—Bill of Spirit-Duck.

1991.—Bill of Long-tailed Duck.

1985.—Spirit-Duck : Male.

1988.—Long-tailed Duck : Male.

1986.—Spirit-Duck : Female.



1989.—Long-tailed Duck : Female.

1983.—Canvas-back Duck.

1992.—Steamer-Duck.

1990.—Long-tailed Duck : Male.

1983.—The Canvas-back Duck

(*Fuligula Valisneria*). In the genus Fuligula the bill is flat, broad, long, with only a slight elevation at the base; the nostrils are suboval; the feet are large; the hind toe broadly lobated. Fig. 1984 represents the Beak of the Canvas-back.

The Canvas-back duck, in many points, both of form and colouring, closely approaches our well-known Pochard (Fuligula ferina), but is considerably superior in size. It is a species peculiar to America, breeding from the 50th parallel of N. latitude to the most northern limits of the fur countries. When the season of incubation is over, and the winter sets in, the Canvas-back in large flocks migrates southwards, appearing on the coasts of the United States about the middle of October. A few descend to the Hudson and Delaware, but the great body of these birds resort, according to Wilson, to the numerous rivers belonging to, and in the neighbourhood of Chesapeake Bay, particularly the Susquehannah, the Patapsco, Potomac, and James rivers. It is probable that they extend their migration to the Gulf of Mexico; they are said to be common at the mouth of the river Neuse, near Newbern. It is seldom that these birds advance high up the rivers, but resort to a particular part of tide water, where the long subaquatic valisneria grows in immense quantities, the white tender root of which furnishes them with the most acceptable food. For this, they dive and tear up the plants, which become drifted into matted rows by the wind; the tender portions near the root of the slender marine vegetables, called eel-grasses (Zostera marina and Ruppia maritima), are also eagerly devoured, as well as seeds and grain, which are often scattered over the surface of the water near the coast, from wrecks. Wherever their favourite vegetables abound, these birds assemble, and sometimes in such multitudes as to cover acres of the river; the noise of their wings when they rise disturbed by the gunner resembling the roar of thunder. They are extremely shy, and can only be approached by stratagem; yet are they the object of the sportsman's unceasing persecution, for of all the duck tribe, if we may believe those who ought to know, none can at all compare with them in the exquisite flavour of their flesh. On their first arrival along the shores of the United States, they are lean, but in a short time they become very fat, and then is the flesh superlative. The neck of the Canvas-back, in the male, is of a rich chestnut deepening into black on the upper part of the back and breast, where it abruptly terminates; the rest of the back is white, beautifully pencilled with fine transverse wavy lines of dusky black; the breast and under surface are white, pencilled in the same manner, but more obscurely; quill-feathers pale slate, dusky towards the tips; tail short and greyish brown. Bill black, legs pale ash; length two feet.

In the female, the general plumage is umber brown varied with rufous; the back being finely undulated with greyish white.

1985, 1986.—The Spirit-Duck

(*Clangula albeola*). Male and Female. The Buffel Duck of Pennant; the Buffel's-head Duck of Catesby; the Buffel-headed Duck of Wilson; the Little Black-and-White Duck of Edwards.

In the genus Clangula the bill is narrow, somewhat elevated at the base, contracted towards the tip, with the nostrils inclining to oval, and nearly in the middle of the upper mandible. Though many of the birds of this genus frequent the sea, the species generally occur in rivers and lakes, as is the case with the Golden Eye (Clangula vulgaris), which breeds in the arctic circle, and visits the larger rivers and lakes of our island, and the Continent generally, in the winter. The same observation applies to the beautiful Harlequin Duck (C. histrionica), and to the present species, both natives of America. Fig. 1987 represents the Bill of Clangula albeola.

The Spirit-duck, called Wakaisheeweesheep, Wawhaisheep, and Wappano-sheep by the Cree and Chippeway Indians, is common in the winter to the sea-shore, lakes, and rivers of the United States, where it is celebrated for its remarkable expertness in diving. So suddenly does it disappear, and with such address does it conceal itself, after vanishing under the water, that it has obtained the names of Conjurer and Spirit-duck; magic, as it were, appearing in its movements. Hence it is not often hit, and even if it be, and the shot does not kill it outright, it instantly dives, and thus manages to evade its pursuer. The food of this species consists of small shell-fish, shrimps, sea-weeds, laver (Ulva lactuca), &c., for which it dives in the bays along the coast, and the saline marshes. Its flesh, though fat, is not in much esteem. During the winter, this bird is usually seen in pairs, or small companies, but towards March it assembles in flocks, which leave for the high regions about the middle of April. They are said to breed about Hudson's Bay, where they arrive in June; frequenting the Severn river, and making their nests in hollow trees in woods adjacent to water. The male is a very beautiful bird. The forehead, region of the bill, nuchal crest, and upper sides of the neck rich duck green, blending with the resplendent auricula purple of the top of the head and throat. Broad band from the eye to the tip of the occipital crest, lower half of the neck, the shoulders, exterior scapulars, intermediate and greater coverts, outer webs of five or six secondaries, flanks, and under plumage pure white. Back, long scapulars, and tertiaries velvet black; lesser coverts bordering the wing the same, edged with white; primaries and their coverts brownish black. Tail-coverts blackish grey; tail broccoli brown; under tail-coverts greyish. Bill bluish black. Legs yellowish. In many spring specimens the under plumage is ash-grey. Length about sixteen inches.

The female, which is considerably smaller, has the head and back of a dark blackish brown; the fore-part of the back, scapulars, and tertiaries, edged with yellowish brown. Fore-part of the neck, sides of the breast, and flanks, blackish grey; breast and belly white, glossed with brownish orange. White band on the ears and occiput much narrower than in the male. The white speculum is less perfect, and the whole of the lesser coverts and scapulars are unspotted blackish brown. Bill and feet brownish.

1988, 1989, 1990.—The Long-tailed Duck

(*Harelda glacialis*). Canard à longue queue of the French; Eisente of the Germans; Swallow-tailed Duck of the Hudson's Bay residents; Hwyad gynffon gwennol of the ancient British.

In the genus Harelda the bill is very short, high at the base, and arched; the laminæ are large, prominent, and distant; nostrils oblong and nearly basal. Fig. 1991 represents the Bill of Harelda glacialis.

This active duck, which emulates the Spirit-duck in its wonderful aquatic evolutions, is a native of the dreary regions of the arctic circle, making along the grassy shores a nest of herbage, which it lines with fine down from its breast. The eggs are five in number, and of a pale greenish grey. After the season of incubation, these birds collect in vast flocks, and as the cold season advances, migrate southwards, but not before the polar seas are thoroughly ice-bound. It visits the shores and lakes of the United States, Norway, Sweden, Russia, Germany, and the islands and lakes of Scotland, but is seldom seen on our southern shores. Its flight is wonderfully rapid, but not at a great elevation, or long protracted; and its cry is loud and almost incessant, and when uttered by congregated multitudes resounds to a considerable distance.

The male of this species differs considerably from the female in plumage, and the livery of summer differs from that of winter.

1992.—The Racehorse, or Steamer-Duck

(*Micropterus brachypterus*). Oidemia Patachonica, King; Anas brachyptera, Latham; Racehorse of Captain Cook; Steamer-duck of Captain King.

This extraordinary duck leads us away from the Northern to the Southern hemisphere. It is a native of the Falkland Islands, Tierra del Fuego, and Patagonia, and from the shortness of its wings is incapable of flight; while, on the other hand, they aid it in skimming with extraordinary speed the surface of the water, and also in diving to the bottom of the sea. The limbs are immensely thick and powerful, the neck short, and the bill stout, deep at the base, but abbreviated. It is described by Captain Philip Parker King, R. N., in the Zoological Journal.

It was, says Captain King, at Eagle Bay, beyond Cape San Isidro (Point Shut-up of Byron), in the Strait of Magalhaens, that "we saw for the first time that most remarkable bird the Steamer-duck. Before steam-boats were in general use, this bird was denominated, from its swiftness in skimming over the surface of the water, the 'racehorse,' a name which occurs frequently in Cook's, Byron's, and other voyages. It is a gigantic duck, the largest I ever met with. It has the lobated hind toe, legs placed far backwards, and other characteristics of the oceanic ducks. The principal peculiarity of this bird is the shortness and remarkably small size of the wings, which, not having sufficient power to raise the body, serve only to propel it along, rather than through the water, and are used like the paddles of a steam-vessel. Aided by these, and its strong broad-webbed feet, it moves with astonishing velocity. It would not be an exaggeration to state its speed at from twelve to fifteen miles an hour. The peculiar form of the wing and the short rigid feathers which cover it, together with the power this bird possesses of remaining a considerable time under water, constitute it a striking link between the genera Anas and Aptenodytes (Penguins). It has been noticed by many former navigators. The largest we found measured forty inches from the extremity of the bill to that of the tail, and weighed thirteen pounds: but Captain Cook mentions, in his second voyage, that the weight of one was twenty-nine pounds. It is very difficult to kill them, on account of their wariness and thick coat of feathers, which is impenetrable by anything smaller than swan-shot. The flavour of their flesh is so strong and fishy, that at first we killed them solely for specimens. Five or six months however on salt provisions taught many to think such food palatable, and the seamen never lost an opportunity of eating them. I have preferred these ducks to salt beef, but more as a preventive against scurvy than from liking their taste. I am averse to altering names, particularly in natural history, without very good reason; but in this case I do think the name of 'steamer' much more appropriate and descriptive of the swift paddling motion of these birds than that of 'racehorse.' I believe, too, the name of 'steamer' is now generally given to it by those who have visited these regions."

Mr. Darwin, in his notice of the same bird, says that it proceeds partly by swimming and partly by flapping the surface of the water. "The manner is something like that by which the common house duck escapes when pursued by a dog; but I am nearly sure that the steamer moves its wings alternately, instead of both together, as in other birds. These clumsy loggerheaded ducks make such a noise and splashing, that the effect is exceedingly curious."

This species feeds on crustacea and shell-fish, &c. The general plumage above is lead-colour, with a tinge of grey; under parts white, speculum or beauty spot of wings white; at the bend a blunt spur. Bill yellow with the nail black: legs dusky yellow. Length forty inches; of bill, three inches.

In the 'Proceeds. Zool. Soc.' Dec. 14, 1830, a second species from the western parts of the Straits of Magalhaens (Magellan), is described by Captain King, under the title of Micropterus Patachonicus. It is inferior in size to the preceding.

We shall now pass from the Ducks to the Geese; of which our ordinary domestic breed is deduced from the Greylag (Anser palustris, Flem.; Anser cinereus, Meyer), which was formerly very abundant in England, breeding in the fenny counties. We have besides the Common Goose, the Chinese Goose, (Anser cygnoïdes) which is larger and more swan-like in its form than the preceding, having a long and slender neck. It is a native of China and other parts of Asia, and is said to occur in Africa. It is the Oie de Guinée of Buffon. A third goose, the Canada Goose (Anser Canadensis), is not uncommon in a state of domestication in our island, but is kept rather as an ornament to ponds and sheets of water, than for the sake of its flesh. In America, where it is domesticated, the farmers regard it as good and more profitable than the ordinary tame goose of Europe.

1993.—The Canada Goose

(*Anser Canadensis*). This species, of which, as we have said, there is a tame breed both in Europe and America, is a native of the arctic regions of North America, whence, in the autumn, vast flocks wing their way southwards, spreading over Canada and the United States. The autumnal flight, says Wilson, lasts from the middle of August to the middle of October, when the frosts begin. No sooner do they arrive in Canada and the States, than the work of slaughter commences. They run the gauntlet, so to speak, for many hundreds of miles, through such destructive fires, that by the time they have reached the shores of the middle States, their numbers are not only greatly reduced, but the survivors have become exceedingly shy and watchful. The English residents at Hudson's Bay depend greatly on the supply of Canada Geese for their winter provision; and it is stated that in favourable years, as many as three or four thousand have been killed and barrelled up; a single native, from the ambush of his bough hut, will sometimes kill two hundred in a day. Those which are taken when the frost begins to set in are preserved in a frozen state, with the feathers on, and not salted, as the rest; the feathers constitute an article of commerce and are sent to England. The flesh of this species, though juicy and excellent, is not equal to that of the Snow goose (Anser hyperboreus), which, according to Dr. Richardson, is of first-rate quality; consequently thousands of this latter species are killed during their southern progress, and kept in a frozen state, in holes dug in the ground, and covered up with earth. The same mode of preserving them is practised also in Siberia.

About the middle of April the Canada geese return northwards, their flight lasting till the middle of May. They have been found breeding on the coasts of Labrador. On the arrival of the flocks in

the fur countries the work of slaughter again commences, the natives attracting the birds within gunshot range by imitating their call note. "One goose," says Dr. Richardson, "when fat weighs about nine pounds, and is the daily ration for one of the company's servants during this season; it is reckoned equal to two snow geese, or three ducks, or eight pounds of buffalo or moose meat, two pounds of pemmican, or a pint of maize and four ounces of suet. About three weeks after their first (vernal) appearance, the Canada geese disperse, in pairs, throughout the country between the 50th and 67th parallels to breed, retiring at the same time from the shores of Hudson's Bay. They are seldom or ever seen on the coasts of the Arctic Sea. In July after the young are hatched, the parents moult, and vast numbers are killed in the rivers and small lakes, when they are unable to fly. When chased by a canoe and obliged to dive frequently, they soon become fatigued, and make for the shore with the intention of hiding themselves, but as they are not fleet they fall an easy prey to their pursuers. In the autumn they again assemble in flocks on the shores of Hudson's Bay for three weeks or a month previous to their departure southwards."

The food of the present species consists of tender aquatic herbage, and roots, and also marine plants, together with grain and berries.

The Canada goose has the head, nearly all the neck, the greater quills, rump, and tail black. Back and wings brown, with a pale edge to each feather. Base of the neck and under plumage white, a few feathers before the edge, and a large throat-mark white. Bill and feet black.

1994.—The Bean Goose

(*Anser Segetum*, Steph.). Anser ferus, Flem.

The Bean goose or Small Grey goose must not be confounded with the Greylag, the origin of our domestic stock, and from which it may be distinguished by its inferior size, and by the form of the bill, which is comparatively shorter, smaller, and more compressed towards the end. Its wings reach even beyond the tail. Moreover, in the bean goose the base of the upper mandible as far as the nostrils and of the lower, together with the nails of both, are black, the rest of a reddish flesh-colour inclining to orange, whereas the bill of the greylag is of an orange red, with the nail of a greyish white.

The bean goose is a native of the high northern regions, and the range of country within the arctic circle; whence in the autumn it migrates southwards, and is well known as a regular winter visitant to our islands, arriving about the beginning of October. The flocks have their respective feeding districts or haunts, to which, as Mr. Selby has satisfactorily determined, they invariably return; their flight, except during stormy weather, is generally at a great elevation, and extremely rapid. The birds fly either in a diagonal line, or form two sides of an acute triangle, and during their aërial progress maintain an incessant cackle, the voices of the two sexes being easily distinguished. During the day, the flocks resort to the upland grounds and open lands, feeding on the tender wheat, and also upon clover and other herbage. In the early part of the spring they visit the fields newly sown with beans and peas, and greedily devour as much as they find scattered about, or can dislodge; on the approach of evening they retire to the water, or to some bar of sand, at a little distance from the shore, where they have a free range of vision all around, and no enemy can steal unobserved upon them. They are extremely watchful and vigilant, and it is only by stratagem that the sportsman can come upon them within gunshot. The best plan is to lie in wait for them when they make their early morning visit to the feeding grounds which they habitually frequent.

The bean goose is said to breed on some of the outermost Western islands in considerable numbers, making in the marshy grounds a nest of dried grasses and other vegetables; the eggs are ten or twelve in number.

The bean goose is much more common in our island than the greylag, at least in the present day: for formerly the greylag was not only numerous, but a permanent resident, breeding in the fenny counties, from which the process of draining, and an increase of population, have almost entirely banished it. For the description of a recently determined species, the Pink-footed goose, closely allied to the bean goose, see 'Proceeds. Zool. Soc.' 1839, p. 3. It is the Anser phœnicopus of Mr. Bartlett.

1995, 1996.—The Bernicle Goose

(*Anser Bernicla*). The Bernicle, together with a closely allied species, the Brent goose (Anser Brenta), are both natives of the high northern latitudes, both of Europe and America, and in autumn migrate southwards; they visit our islands during the winter; the bernicle goose resorts to the western shores of Britain and the north of Ireland, and is abundant on the coast of Lancashire and in the Solway Frith; while the brent goose chiefly haunts the eastern and southern shores of Britain, and abounds on the Northumbrian coast. Both species are very shy and wary, and can only be approached by means of the most cautious manœuvres. They frequent marshy ground covered with spring-tides, feeding upon seashore grasses, the fronds of various algæ, and particularly of the laver.

The bernicle breeds in Iceland, Spitzbergen, Greenland, Lapland, the north of Russia and of Asia, and the neighbourhood of Hudson's Bay. It is of handsome form, and, from the length of the tarsi, stands high on the limbs; its flesh is very excellent.

As the bernicle or bernacle goose and the brent goose have till recently been confounded together, the fabulous origin attributed to the one involves that of the other also. It is strange that in matters concerning the marvellous, even men of education will take pains to deceive themselves, and, instead of investigating nature with a "learned spirit," give a licence to ill directed imagination, and credit absurdities. When such men are so credulous, how can we wonder at the superstitions of the illiterate?

The first phase of the story in question is, that certain trees, resembling willows, more particularly in one of the Orkneys, Pomona, produced at the ends of their branches small swelled balls, containing the embryo of a duck suspended by the bill, which, when ripe, fell off into the sea and took wing. Munster, Saxo Grammaticus, Scaliger, Fulgosus, Bishop Leslie, and Olaus Magnus, all attested to the truth of this monstrous absurdity. Gesner, Johnston, and Aldrovand may be also cited. Fig. 1997 is a copy of the bernacle goose-tree, from Aldrovand, displaying the pendent fruit, in due time to undergo their wonderful transformation.

A second phase or modification of the story is that given by Boëce, the oldest Scottish historian: he denies that the geese (Scotticè, Claiks) grow on trees by their bills, as some believe, but that, as his own researches and personal experience prove, they are first produced in the form of worms, in the substance of old trees or timber floating in the sea; for such a tree, cast on shore in 1480, was brought to the laird, who ordered it to be sawn asunder, when there appeared a multitude of worms, "throwing themselves out of sundry holes and bores of the tree; some of them were rude, as they were newshapen; some had both head, feet, and wings, but they had no feathers; some of them were perfect shapen fowls. At last the people, having this tree each day in more admiration, brought it to the kirk of St. Andrew's, beside the town of Tyre, where it yet remains to our days." Other instances he adduces by way of proof, and at length he comes to the conclusion, that the production of these geese from fruits is the erroneous opinion of the ignorant; it being ascertained that "they are produced only by the nature of the ocean sea, which is the cause and production of many wonderful things." In this view he was supported by Turner and others: "When," says Turner, "at a certain time an old ship, or a plank, or a pine-mast rots in the sea, something like a little fungus at first makes its appearance, which at length puts on the manifest form of birds; afterwards these are clothed with feathers, and at last become living and flying fowl." ('Avium Præcip. Hist.,' art. 'Anser.') Turner, however, does not give up the goose-tree, but informs Gesner that it is a different bird from the brent or bernicle goose, which takes its origin from it. (Gesner 'De Avibus,' iii., p. 107, &c.) Passing a host of other authorities, with their accumulated proofs, and the depositions of unimpeachable witnesses, we may come to Gerard, who, in 1636, published in his 'Herbalist' a detailed account as follows:—

"But what our eyes have seene and hands have touched we shall declare. There is a small island in Lancashire, called the Pile of Foulders, wherein are found the broken pieces of old and bruised ships, some whereof have been cast thither by shipwracke, and also the trunks and bodies with the branches of old and rotten trees, cast up there likewise; whereon is found a certaine spume, or froth, that in time breedeth into certaine shels, in shape like those of the muskle, but sharper pointed, and of a whitish colour; wherein is contained a thing in form like a lace of silke finely woven, as it were, together, of a whitish colour; one end whereof is fastened into the inside of the shell, even as the fish of oisters and muskles are; the other end is made fast unto the belly of a rude masse or lumpe, which in time commeth to the shape and form of a bird: when it is perfectly formed the shell gapeth open, and the first thing that appeareth is the foresaid lace or string; next come the legs of the bird hanging out, and as it groweth greater it openeth the shell by degrees, till at length it is all come forth and hangeth only by the bill: in short space after it commeth to full maturitie, and falleth into the sea, where it gathereth feathers, and groweth to a fowle bigger than a mallard and lesser than a goose, having blacke legs and bill or beake, and feathers blacke and white, spotted in such manner as is our magpie, called in some places a pie-annet, which the people of Lancashire call by no other name than a tree-goose; which place aforesaid, and all those parts adjoining, do so much abound therewith, that one of the best is bought for three pence. For the truth hereof, if any doubt, may it please them to repaire unto me, and I shall satisfie them by the testimonie of good witnesses."

Fig. 1998 represents the illustration given by Gerard of this account. It is apparently intended for a log of wood rising out of the sea crowned with these goosebearing shells.

We must not suppose that there were none who doubted this marvel. Belon, who wrote in 1551, and others, treated it with ridicule; and in Ray's 'Willüghby,' published in 1678, we find a refutation of it, only with an admission of spontaneous generation among certain animals of the lower orders.

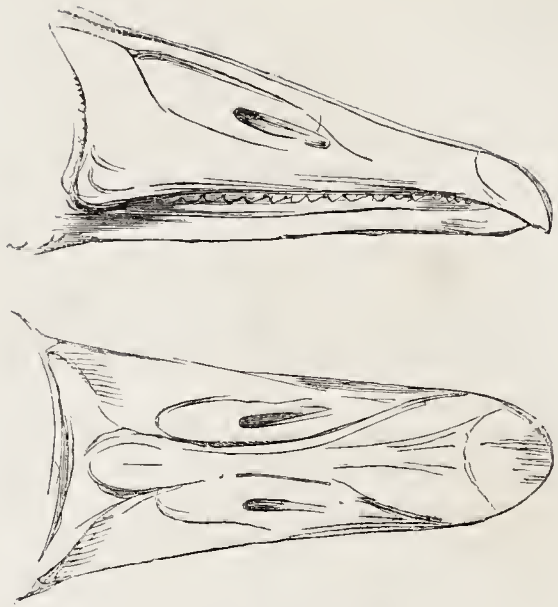
What, it may be asked, were the marine animals supposed to be the origin of this goose? Simply those singular shell-covered cirrhipedous creatures supported on, or rather attached, often in thousands, to floating timber by means of long flexible wormlike stalks or peduncles. They are known by the name of Bernacles, or Bernieles (Pentelasmis anatifera, Leach; Lepas Anatifera, Linn.). The body of these curious creatures is enclosed in a shell not unlike that of a muscle, but composed of five portions, one a dorsal stripe: along the anterior margin the valves are but partially connected by a membrane, leaving a large fissure, through which emerge the ciliated arms or cirrhi, plumose and jointed. The colour of the shell is pale purplish blue. Of these animals we shall hereafter have occasion to speak more particularly. We present a representation of them at Fig. 1999. How it came to pass that the absurd tradition we have briefly detailed arose, is beyond our conjecture.

To return to the bernicle goose (for so it is still called), its weight is about five pounds; the bill is black with a reddish streak on each side; the cheeks and throat, with the exception of a black line from the eye to the beak, white; head, neck, and shoulders, black; upper plumage marbled with blue, grey, black, and white. Tail black; under parts white; legs dusky. We may here refer to the figures of the bill of various species of goose, presented in order that the differences of form assumed may be the more easily compared together. Fig. 2000 represents the Bill of the Snow Goose (Anser hyperboreus). Fig. 2001 the Bill of the Greylag, already described. Fig. 2002, the figure of the Bill of the Egyptian Goose (Chenalopex Ægyptiacus). Fig. 2003, the Bill of the Bernicle Goose. Fig. 2004, the Bill of the Cereopsis Goose (Cereopsis Novæ Hollandiæ).

2005.—The Egyptian Goose

(*Chenalopex Ægyptiacus*). The Egyptian Goose is abundant along the banks of the Nile, and is distributed over the continent of Africa generally. It also visits the southern shores of Europe, and is not uncommonly seen in Sicily. According to Temminck it was this species which was held in veneration by the ancient Egyptians, and of which figures are frequently observed among the monumental remains of that extraordinary nation. The author of 'Egyptian Antiquities,' vol. ii. p 311 ('Library of Entertaining Knowledge'), also observes that the chenalopex of Herodotus, still very common in Egypt, is of frequent occurrence on the sculptures, though, as he says, it was not a sacred bird, unless it may have some claims to that honour from having been a favourite article of food for the priests. "A place in upper Egypt had its name Chenoboscium or Chenoboscia (goose-pens) from these animals being fed there, probably for sale." There is good reason, however, to believe that the ordinary common goose was kept, as well as the chenalopex. The ancients regarded the eggs of this species as second in flavour only to those of the pea-fowl. Ælian mentions the bird and notices its cunning and wariness. Hence the word χηναλώπηξ, from χήν, a goose, and ἀλώπηξ, a fox. The Egyptian goose is often kept because of its beauty in a semi-domesticated state on ornamental sheets of water, both in our country and on the continent, and in that condition it breeds freely: hence it happens that the young when fledged often take wing, and wandering about on rivers or lakes, are shot; a circumstance, as Mr. Gould observes, which occurs yearly. The habits of this goose closely resemble those of the rest of the tribe. The bill is long, slender, and nearly straight, rounded at the tip; the upper mandible is slightly curved, and the nail hooked; refer to Fig. 2002. The tarsi are elongated; the neck is long and slender; the general contour compact

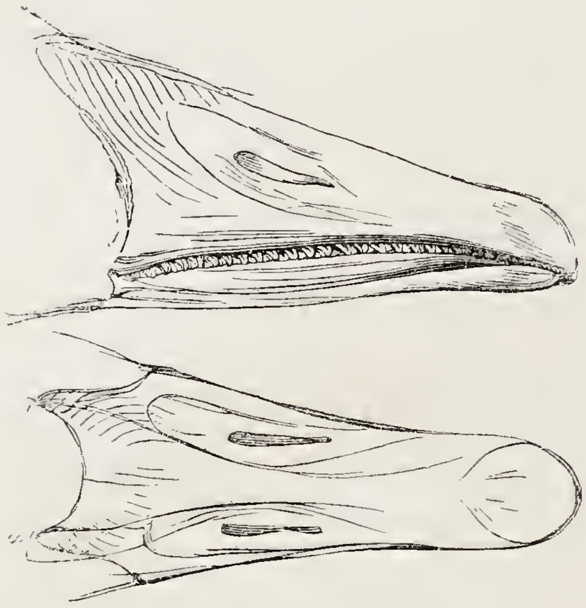
1994.—Bean Goose.



2001.—Bill of Grey-lag Goose.

1993.—Canada Goose.

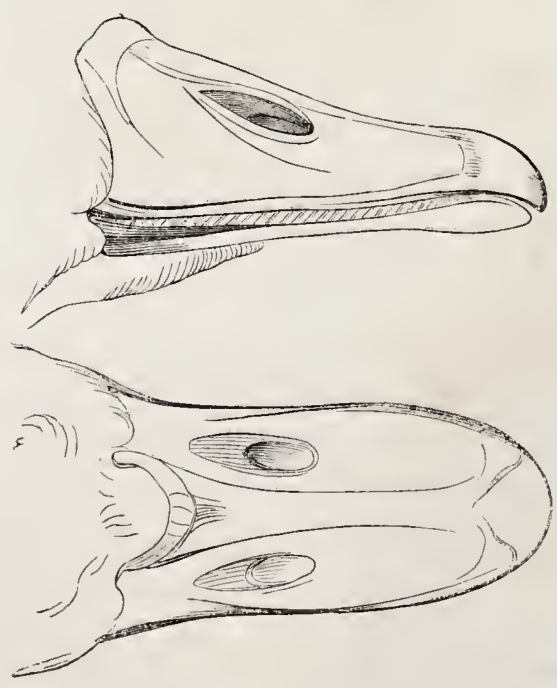
1995.—Bernicle Goose.



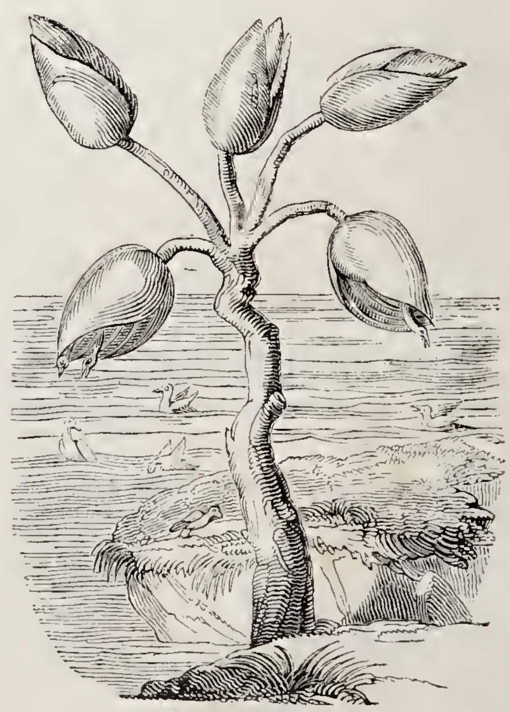
2000.—Bill of Snow Goose.

1997.—Bernicle Goose-tree. (From Aldrovand.)

1996.—Bernicle Goose.



2002.—Bill of Egyptian Goose.

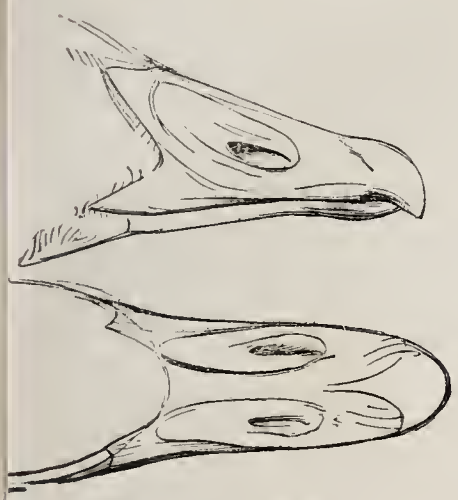


1998.—Bernicles transforming into Geese. (From Gerard.)

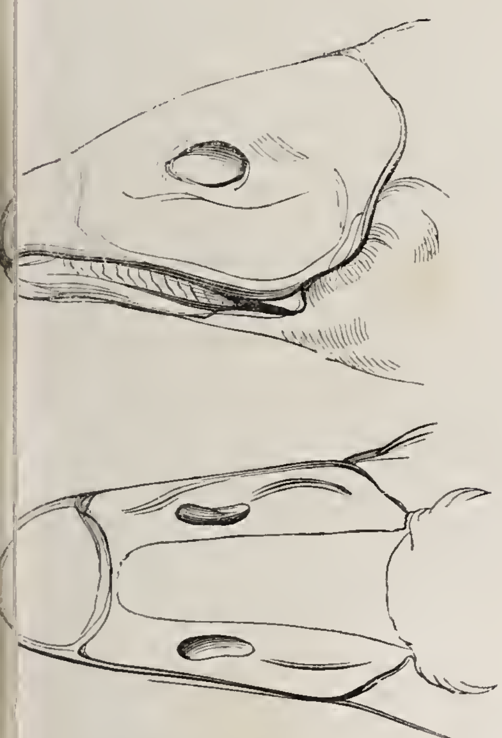
2005.—Egyptian Goose.

1999.—The Bernicle.

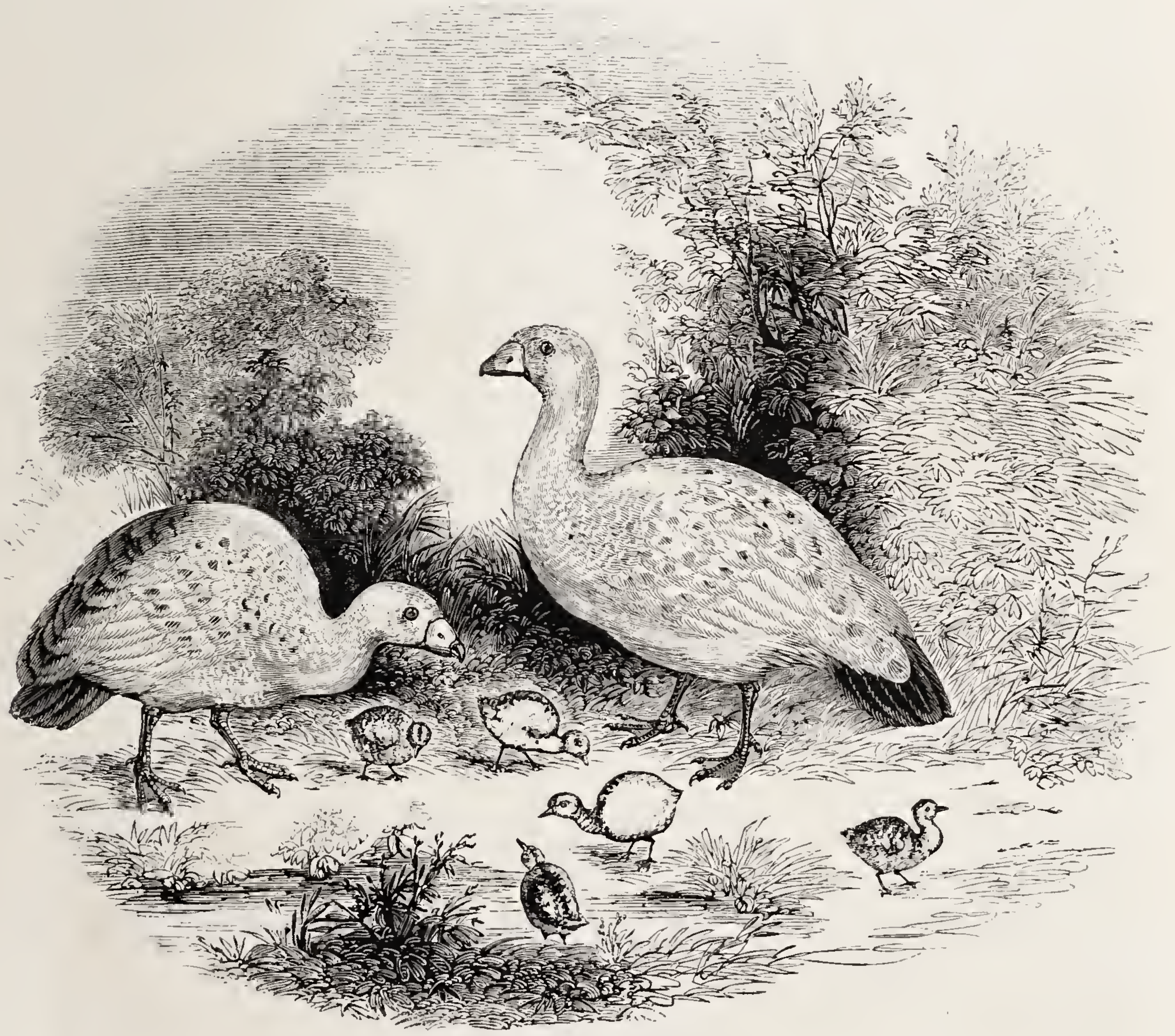
2006.—Cereopsis Geese.



2003.—Bill of Bernicle Goose.



2004.—Bill of Cereopsis Goose.



2007.—Cereopsis Geese and Young.

2008.—Flocks of Geese. (From 'Egyptian Antiquities.')

2009.—Ancient Egyptian Ornamental Garden.

2006, 2007.—The Cereopsis Goose

(*Cereopsis Novæ Hollandiæ*). This beautiful bird decidedly forms the type of a distinct genus, of which, however, it is the only known species. According to some naturalists it evinces a certain degree of approximation towards the Ardeidæ (Herons), a point on which we are by no means satisfied, for though less completely organized for swimming and diving than many of the Anatidæ, still neither in food nor in habits, nor in the essential points of its anatomy, does it resemble the herons. The fact is that the theory of circles or given groups inosculating by means of intermediate forms stands on a frail basis. The cereopsis exhibits the leading characters which distinguish the geese from the ducks, carried out still more decidedly. The beak is shorter, the legs longer, and the feet less webbed than in most geese: we may add to this that the bill is elevated, obtuse, and covered, except at the tip, with a cere, or membrane, on which are the nostrils. The legs are bare of feathers a little way above the tarsal joint; the nails are strong, and the wings ample. Refer to Bill of Cereopsis, Fig. 2004.

The cereopsis is a native of New Holland; and though most voyagers who have visited the distant shores on which it abounds have alluded to it as a species of swan, or as a goose, it is only within the last few years that naturalists at home have gained an accurate knowledge of its true characters and its natural affinities. The first introduction of the cereopsis into the records of science was by Dr. Latham in the year 1802. He published at that time a figure and description of the bird in question in the second supplement to his 'General Synopsis,' regarding it as the type of a new genus among the waders, and to this genus he gave the title of Cereopsis, the specific designation of the bird, of which indeed he had seen only one example, being Cereopsis Novæ Hollandiæ. The term cereopsis contains an allusion to the large cere covering the base of the bill, but which Dr. Latham, misled by an apparently imperfect specimen, supposed to be extended on the forehead and face; as it is, however, the cere is so extensive as to justify the title. Subsequently to the publication above alluded to, Dr. Latham had the opportunity of examining another specimen, from which he took the description published in his 'General History,' vol. ix. p. 432, where he corrects his former views with regard to the extent of the cere, but with an assurance, in a foot-note, that in the specimen first seen the cere extended far beyond the eyes. Still, strange to say, he retained the cereopsis among the wading birds, observing, "Mrs. Lewin informs me, that it is in sufficient plenty in some parts of New Holland, and, from its being so about Cape Barren, has obtained the name of Cape Barren Goose. It certainly at first sight appears not unlike that bird, but in the bill it entirely differs from any of the genus, and the legs are bare a great way above the joint, although it must be owned that the feet, having a considerable membrane between the toes, would otherwise bring it to class with the web-footed." Mrs. Lewin adds, "that it becomes very tame and familiar, so as to be domesticated with our common goose, and that the flesh is well flavoured." On the Continent, where, until Temminck figured it in his Planches Coloriées as appertaining to the swimming birds, it did not appear to be known, it was regarded, on the authority of Latham, as a wader. After Temminck, it was also figured by Vieillot as a swimming bird; but the figure, although sufficiently characteristic, is in one point erroneous, inasmuch as it gives the cere extending over the top of the head. In 1831 Mr. Bennett described and figured the cereopsis in the 'Gardens and Menagerie, &c., delineated;' his figure, which is very accurate and characteristic, being taken from a specimen in the Gardens of the Zoological Society, the Society having, at that time, eight living individuals. These, as he observed, then exceeded "in number all the stuffed specimens that exist in public collections in Europe, the latter, so far as we are aware, being limited to one in the British, one in the Paris, and one in the Berlin Museums." Two specimens of adults, and one or two of young individuals, are in the Museum of the Zoological Society.

Though Vieillot figured the cereopsis, he appears not to have suspected its identity with a bird previously described by him in the 'Nouveau Dictionnaire d'Histoire Naturelle' as the Cygne andré, from the characters detailed by M. Labillardière (see his account of the voyage of D'Entrecasteaux in 1792), "who mentions the occurrence, in Espérance Bay, on the south coast of New Holland, of a new species of swan, rather smaller than the wild swan, of an ashy grey colour, somewhat lighter beneath, with a blackish bill, covered at the base by a tumid brimstone-coloured cere, and legs slightly tinged with red." By way, however, of confusing the species still farther, M. Vieillot described a specimen brought home by M. Labillardière from Van Diemen's Land, and deposited in the Paris Museum, as a species of goose, under the title of Anser griseus. D'Entrecasteaux informs us that Riche, one of the naturalists attached to his expedition, had described the bird under the title of Anas Terræ Leeuwin.

The habits of the cereopsis, in a state of nature, have been succinctly detailed by various voyagers. Most probably it is migratory, at least to a certain extent; for Captain Flinders found it more abundant on Goose Island in some seasons than in others. It frequents grassy districts and the shore, but rarely takes to the water, its food being exclusively grass. Both at Lucky Bay and Goose Island these birds were very abundant, and so tame that the crew of Captain Flinders had no difficulty in knocking them down with sticks, or even in taking them alive. M. Bailly reports to the same effect respecting those seen by him at Preservation Island; and Labillardière says, that at first they were so little alarmed by the presence of man, as to suffer themselves to be taken by the hand; but in a short time they became aware of their danger, and took to flight on the approach of any one. All agree as to the delicacy of its flesh. From the ease with which the cereopsis becomes domesticated, we are not without hope of seeing this bird added to the list of those which enliven our farmyards, and contribute to the luxuries of our table. It breeds freely in our climate, and feeds like the common goose, but is even more familiar, and requires only ordinary attention. Its voice is deep, hoarse, and clanging. In size, this species equals the common goose. The top of the head is pale grey; the rest of the plumage slate-grey, each feather on the back and shoulders being margined with a paler tint, while the greater coverts and the secondary quill-feathers have a round dusky spot near the extremity; the quills and tail-feathers dusky black; tip of the bill black: cere yellow; tarsi orange-yellow; toes and webs black.

Fig. 2007 represents a pair of these birds with their young.

When in charge of their young the adults are very pugnacious, driving other birds to a distance with great spirit; and even at other times this jealousy of their companions in captivity is but little abated, as we have remarked in the specimens at the Gardens. The black swan from New Holland displays a similar spirit, and will not endure the approach of its snow-white relative; indeed, we know of instances in which white swans have not only been seriously injured, but even killed by their dusky rivals.

Fig. 2008 is the Copy of an Egyptian painting in the British Museum, of great interest notwithstanding its mutilation. It is divided into two compartments. In the upper "on the left is a figure squatted, probably the farmer or some superintendent, and two figures approaching it. Another, with his back turned towards them, is feeding a flock of geese, all of which have red legs and beaks, but in other parts of their bodies there are varieties of colouring." The lower compartment represents on the left hand a person apparently making an offering, but this is doubtful. "Behind this figure is a man who holds a goose by the wings, as is often done now; he is going to put it into a basket, of which we see five; one above another each with a goose or more in it." Behind this figure is a flock of geese, with a driver amongst them, holding in his hand a long rod, painted red. At the right extremity are a couple of geese, and a flock of goslings represented with great fidelity. "There must have been a great demand for geese in Egypt, as they appear to have been a common article of food. The priests were not allowed to eat fish, but were recompensed for this privation by a plentiful supply of beef and goose." The geese represented appear to us to be of the ordinary domestic race.

Fig. 2009 represents an ornamental Pond in an Egyptian garden, with a border of flowers around it, encircled by fruit-trees; in the pond are lotus flowers, as well as fish, ducks, and geese (perhaps chenalopex), with their goslings; all probably kept for pleasure, for it would appear, as this and other paintings prove, that the Egyptian gardens were not only laid out with all the stiffness and formality of an old Dutch garden, but carefully cultivated and adorned.

Fig. 2010 represents, in the centre, a table on which we see a goose that has been killed, and plucked, excepting the head, &c., and, but that the legs and part of the wings are cut off, much resembling those with which the shops of the London poulterers are so plentifully stored at Michaelmas. There is also the shoulder of a sheep or calf, and flowers and fruits are ranged around.

From the Geese we pass on to the Mergansers (goosander, smew), in which we find the beak straight, narrow, and comparatively slender; subcylindrical anteriorly, abruptly hooked at the tip, and with the margins of both mandibles armed with sharp serrations, or tooth-like processes directed backwards, and well calculated for holding slippery prey, as fishes, &c.; the tongue is slender. The feet are large and fully webbed; the hind toe is placed rather high on the tarsus and lobated. The limbs are placed behind the point of equilibrium. Fig. 2011 represents the Bill of Merganser. Fig. 2012, the Foot.

The Mergansers are completely aquatic in their habits, and dive, either in order to evade pursuit, or in chace of their finny prey, with astonishing ease and rapidity. While swimming, they appear as if deeply sunk in the water, owing to the remarkable flatness of the body. Their flight is strong and vigorous, but on land their actions are embarrassed. Natives of the colder latitudes, they are migratory in their habits, passing southwards on the approach of winter. Three species visit our coasts, and the mouths of our larger rivers, as also those of the warmer and temperate parts of the Continent. In their habits these birds are extremely shy and wary, and appear to be incapable of domestication. Their flesh is rank and disgusting. The young birds of both sexes resemble the female parent in plumage, which is very different in colouring from that of the male, whose livery is rich and variegated. The species are not numerous.

2013.—The Goosander

(*Mergus Merganser*). Le Harle of the French; Garsen-säger and Taucher-gans of the Germans; Mergo, Oca marina, and Mergo dominicano of the Italians. It is also the Sugherone of the Italians; the Meer-rack and See-rack of the Germans; Hwyad ddanhedog of the ancient British; Bieure of the old French; Dundiver, Sawbill, Jacksaw, &c., provincial English.

This fine species is a native of the high northern regions of Europe, Asia, and America, where amidst morasses along a dreary coast it makes its nest and rears its brood. It has been seen in Japan. Mr. Selby states that in the northern parts of Scotland, the Orkneys, and other adjacent islands it is a permanent resident, finding subsistence throughout the year either on the fresh-water lakes of the interior, or, when these are frozen, in the deep indentations of the coast, formed by the saline lochs so numerous in that part of the kingdom. In the south of England, excepting during very severe winters, it is rarely seen, but then in small parties of seven or eight; in Holland and Germany, however, where extensive inland fresh waters abound, it is tolerably common. It is much more rare in Italy. Dr. Richardson observes that this species merely winters in Pennsylvania, where it is not abundant, and returns to the fur countries to breed. It is found in Iceland, Greenland, Siberia, Kamtschatka, &c. The goosander, excepting when on the wing, is generally seen on the water, where it is completely at home; diving in pursuit of fish, which when seized are securely held in its serrated bill. It has the power of remaining submerged for a long time; and its subaquatic progress is surprisingly rapid. The nest of this species is placed near the edge of the water, and consists of grass, roots, and fibres, with a lining of down. It is sometimes concealed among stones, sometimes in long tufted herbage, and sometimes even in the hollow stumps of decayed trees. The eggs, twelve or fourteen in number, are of a cream-yellow.

The old male goosander in full plumage is a beautiful bird, and has the head thickly tufted, this and part of the neck being greenish black, the reflection varying in different lights; lower part of the neck, breast, under parts, coverts of the wings and scapulars farthest from the body, tinged of a yellowish rose-colour (which soon fades in stuffed specimens to white); upper part of the back and scapulars nearest to the body deep black; quills blackish, great coverts bordered with black; rest of the back and tail ash-coloured; beauty-spot on the wing white, without transverse bands; bill deep red, black above and on the terminal nail; iris reddish brown, sometimes red: feet vermilion red. Length twenty-six to twenty-eight inches. (Temm.)

The lower figure is the male, the upper the female.

The trachea of the male has two enlargements while running down the neck, and a large bulla at the bifurcation in the chest.

2014.—The Smew

(*Mergus albellus*). Le petit Harle huppé, ou la Piette of Buffon; Weisser-säger and Kreutz-ente of the Germans. Merga oca, minore, and cenerino, of the Italians; Lleian-wen of the ancient British; White Nun, Vare Widgeon, and Smee, provincial English.

Like the preceding species this bird is a native of the arctic regions of both worlds, whence it migrates southwards in autumn, and in severe winters is not uncommon on our eastern coasts, about the mouths of our rivers, and in the fenny districts. It is re-

markable, however, that the majority of those which visit our island are females or young males, adult males in their full garb being comparatively seldom met with. It is abundant during the winter in Germany, France, and Holland, and is not uncommon in Italy. With other mergansers it frequents the river Wolga; and has been observed in Japan. In America, according to Wilson, it may frequently be seen on some of the lakes of New England, and of the state of New York; but it returns to the fur countries to breed. Bonaparte states that at Philadelphia it is very rare, and adventitious.

The smew has all the habits of its race, and is vigorous on the wing, and quick and active as a diver, feeding on fish, small crustacea, and insects. It is extremely shy and wary. Its mode of nidification resembles that of the goosander, and the eggs are yellowish white.

The old male has a great spot of greenish black on each side of the bill, and a similar coloured but longitudinal one on the occiput; the tufted crest, neck, scapulars, small coverts of the wings, and all the lower parts very pure white; upper part of the back, the two crescents which are directed under the sides of the breast, and the edges of the scapulars, deep black; tail ash-coloured; sides and thighs varied with ash-coloured zigzags; bill, legs (tarsi), and toes bluish ash; webs black; iris brown. Length fifteen to sixteen inches.

Female :—Summit of the head, cheeks, and occiput reddish brown; throat, upper part of the neck, belly, and abdomen white; lower part of the neck, breast, sides, and rump bright ash; upper parts and tail deep ash; wings variegated with white, ash, and black. Length fifteen inches.

Young of the Year, similar to the female.

In the male the trachea has one gradual enlargement in its course down the neck, and a considerable bulla at the bifurcation.

Family COLYMBIDÆ, or DIVERS.

The birds of this family display a fitness for diving habits even more decided than is to be found either in the diving ducks or the mergansers, having the characteristics with which such habits are connected carried out to a still higher degree. The plumage is deep, close, silky, and extremely glossy. The bill is long and sharp; the wings are small, concave, composed of stiff feathers, and used for the purpose of giving additional impetus to the body, when under water. The limbs are placed as far back as possible, the tarsus is flattened, so as to cut the water, and the toes, either lobated or webbed, are so arranged as to fold up into a small compass when drawn towards the body in order to give the stroke. The tail is short, or wanting; the body is flat, and hence it appears to float deeply on the surface of the water.

Necessarily embarrassed and awkward on land the Colymbidæ are alert and vigorous on their congenial element, from which they can seldom be forced to take wing, trusting rather to diving than to flight for safety. They rise indeed with difficulty, but having attained a due elevation sweep along very rapidly, and are capable of a long sustained flight.

The first group of this family which we shall notice is that of the Grebes (Podiceps).

2015.—The Eared Grebe

(*Podiceps auritus*). Le Grêbe oreillard of Temminck. In the form of their body, the position and structure of the feet, and the nature of their plumage, the grebes are expressly fitted for the element on which they habitually reside, and in which they chase their finny prey with arrow-like velocity. The head is narrow; the beak long, pointed, and sharp, somewhat compressed at the sides, and slightly inclined upwards towards the tip. The neck is long; the body boat-shaped and flattened; the wings are short, concave, and pointed; there is no tail; the plumage is thick, full, and soft; a dense layer of fine down forms an under-dress, being covered by feathers of a silky gloss and texture, and completely waterproof. The toes differ from those of every other aquatic race of birds. Instead of being webbed, as in the duck tribe and others of the Natatorial order, the toes are separate and flattened, having their edges furnished with a broad stiff membrane, each toe being, in fact, a distinct and beautifully-formed paddle. Of the three anterior toes, the outermost is the longest and largest; the next is nearly as large, and its outer edge lies tile-like over the inner membrane of the outermost; the innermost toe is less than the middle one, on which its outer edge impinges. The hind toe is short, placed high on the leg, and furnished with a lobated membrane. The arrangement of the scales covering the toes gives to them a leaf-like appearance; for the lines dividing the scales run in regular succession obliquely upwards from a central line or shaft, formed by the bones advancing to the tips, which are covered with a broad, flat nail. The leg, or tarsus, is short, and flattened laterally, so as to cut the water when drawn up after each stroke.

Fig. 2016 represents the Foot of the grebe, and well depicts its tri-oared character.

The situation of the legs in the grebe is thrown as far backwards as possible, and the thigh is short, and, as it were, retracted, so as not to advance beyond the body; the grebe, however, cannot sit upright like the penguin, for it does not rest on its heel: it is not plantigrade. When resting on the land it lies prone on its whole body, and in this situation shuffles along like a seal, pushing itself onwards by striking the ground with its feet. Ill adapted for the land, the grebe, as we have seen, is admirably constructed for the water. It swims low, owing to the flatness of its body, and when diving in pursuit of its prey uses its wings to add to its velocity.

The quickness with which the grebes dive is very remarkable; so instantaneously do they plunge, that they are able to avoid the shot from a fowling-piece, fired by a common flint lock, and they will then make a stretch of two hundred yards before coming up to breathe, which is done by merely raising the head for a second above the water. Mr. Selby informs us that, when making a tour through Holland, in company with Sir W. Jardine, he gave chace to a crested grebe, upon one of the lakes in the neighbourhood of Rotterdam, and that though in a boat conducted by those accustomed to the business, it cost upwards of an hour and a half's severe exertion to get within range and secure it by a shot through the neck. The food of this singular group of birds consists of fishes and aquatic insects; but it is observed that the stomach is always found to contain a mass, greater or less, of the feathers of their own body. That these are swallowed to assist digestion, as has been suggested, is not clear; most probably they are involuntarily swallowed during the dressing and cleaning of the plumage, for we often find in the stomach of cows and other ruminants balls of hair; the material being collected into the mouth while licking their own or each others' coats, and then swallowed.

The places chosen by the grebes for their nidification are among the thick reeds and luxuriant aquatic herbage of marshes, or the sedges which border fresh-water lakes and rivers, the nest being composed of a mass of half-decayed roots, dried flags, and other similar vegetable materials. It is large and compact, but roughly put together, and rises or falls according to the rise or fall of the water on which it floats; the eggs are three or four in number, and carefully covered up by the female every time she leaves the nest.

It is only within the last few years that ornithologists have extricated the species of the genus Podiceps from the confusion in which they were left by the earlier writers, who, misled by the great difference existing between the plumage of birds in an immature and adult state, had set down the young as specifically distinct from their parents; nor is this error much to be wondered at, since the differences are not only very considerable as it regards colour, but also as respecting the absence or presence of long ear-tufts, occipital crests, or throat-frills, with which the adults are more or less ornamented during the breeding season. The horned grebe, the eared grebe, and the crested grebe, take their names from the position of these silky plumes, which produce a striking and elegant appearance. We have every reason, however, to believe that they are lost during the winter, being the temporary ornaments of the breeding season. Fig. 2017 represents the Head of the Eared Grebe in full plumage.

The genus Podiceps has a wide geographical range, being found in every quarter of the globe. The following species are common to Northern Europe, Asia, and America :—The Red-neck Grebe (Podiceps rubricollis), a winter visitor to our island; the Crested Grebe (P. cristatus), which breeds in some of the fens of the midland counties of England and in Scotland; the Horned Grebe (P. cornutus), a rare species, but occasionally breeding in the fenny districts of the eastern counties; and the Eared Grebe (P. auritus), also a very rare bird in our island, but occasionally known to breed in the same districts as the preceding.

The Little Grebe or Dabchick, common in the ponds and lakes of our country and spread over the greater part of Europe and Asia, is represented in North America by the P. carolinensis. Several species are peculiar to Australia. The plumage of the male eared grebe in full dress is as follows :—Crown of the head and short ruff round the neck shining black; from behind and below the eyes on each side is a tuft of long, slender, shining orange-buff feathers, which cover the ears and nearly meet behind; throat, neck, sides of breast, and upper plumage deep shining greyish black; secondaries white; under plumage white with a silky lustre; bill black; iris vermilion; legs brown.

Fig. 2015 represents a Male in Full Plumage, and a Young Bird of the Year.

We pass from the grebes to the divers, or loons, which, in most points, bear a close resemblance to the former, excepting that the feet are webbed. Three species are known, natives of the high northern regions of both worlds; they are migratory in their habits, breeding among the fresh-water lakes of the arctic circle, whence they visit the coasts of more southern countries, and those of our islands during the winter, feeding on herrings, sprats, and other fish. The black-throated diver (Colymbus arcticus) and the red throated diver (C. septentrionalis) are said to breed in the Orkneys; they are abundant in Hudson's Bay.

2018.—The Northern Diver

(*Colymbus glacialis*). Greatest speckled Diver or Loon of Willughby; Immer Diver, Ember Goose of Sibbald; Imber, le grand Plongeon of Buffon; Schwarzhalsiger Seetaucher, Eis-taucher, Grosse Hab-ente, and Meer-noering of the Germans; Inland Loon of the Hudson's Bay residents; Turlik of the Greenlanders; Kagloolek of the Esquimaux; Eithennew Moqua of the Cree Indians; Talkijeh of the Chipewayans; Trochydd mawr of the ancient British.

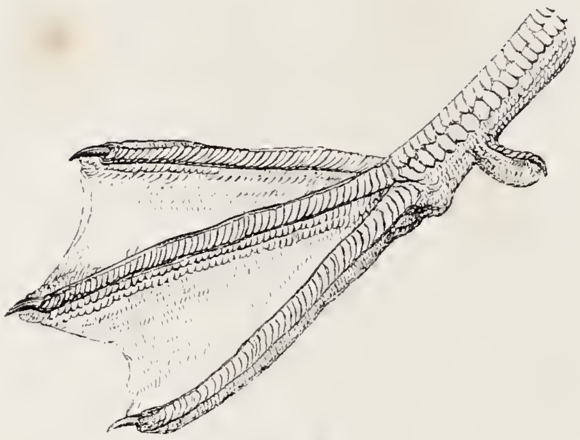
"This fine species inhabits the arctic regions of the globe, migrating southwards in winter, during which season numbers frequent our northern coasts and especially the Frith of Forth, attracted by the shoals of herrings, on which they principally feed. It is occasionally seen about our southern coasts, and has been killed in the Thames below Woolwich. It is remarkable that the great mass of those birds which visit our coast consists of the young of the year, or of the previous year, adults in full plumage being seldom seen, nor are these ever observed on the lakes of Germany, France, or Switzerland. The northern diver breeds on the shores of the inland lakes of the north, and on the islets, which are often studded over by their nests. The eggs, two in number, are large, and of a deep oil green, spotted with purplish red. Dr. Richardson, who had abundant opportunities of observing the manners and habits of the northern diver, remarks that though it "is generally described as an inhabitant of the ocean, we seldom observed it either in the Arctic Sea or Hudson's Bay; but it abounds in all the interior lakes, where it destroys vast quantities of fish. It is rarely seen on land, its limbs being ill fitted for walking, though admirably adapted to its aquatic habits. It can swim with great swiftness, and to a very considerable distance under the water; and, when it comes to the surface, it seldom exposes more than the neck. It takes wing with difficulty, flies heavily, though swiftly, and frequently in a circle round those who intrude on its haunts. Its loud and very melancholy cry, like the howling of the wolf, and at times like the distant scream of a man in distress, is said to portend rain. Its flesh is dark, tough, and unpalatable. We caught several of these birds in the fishing nets, in which they had entangled themselves in the pursuit of fish."

Montagu informs us that one of these birds, captured on our shores, was kept in a pond for some months. "In a few days," he says, "it became extremely docile, would come to the call from one side of the pond to the other, and would take food from the hand. The bird had received an injury in the head, which had deprived one eye of its sight, and the other was a little impaired; but, notwithstanding, it could, by incessantly diving, discover all the fish that were thrown into the pond. When it could not get fish it would eat flesh; and when it quitted the water, it shoved its body along upon the ground like a seal, by jerks, rubbing the breast against the ground; and returned again to the water in a similar manner. In swimming and diving the legs only were used, and not the wings, and by their situation so far behind, and their little deviation from the line of the body, it is enabled to propel itself in the water with great velocity in a straight line, as well as turn with astonishing quickness."

The colours of the adult northern diver are admirably arranged; head and neck jet black, with a broad collar of white striated with black, nearly encircling the lower part of the neck, and a similar, but narrow collar the upper part. Upper plumage glossy black, thickly dotted with square marks of white, disposed in regular rows; sides of the chest white striated with black. Under surface pure white; tail very short; bill black; legs dull black; length thirty-five or thirty-six inches. In the young of the year, the head and upper plumage are generally of a greyish brown; and the under plumage white. After the second moult, a dark band appears along the neck, and the upper plumage begins to assume indications of the adult character, which is still more developed at the third moult, and is perfected at the fourth.

2012.—Goosanders.

2011.—Bill of Merganser.



2012.—Foot of Merganser.

2014.—Smews.

2010.—Ancient Egyptian Painting.

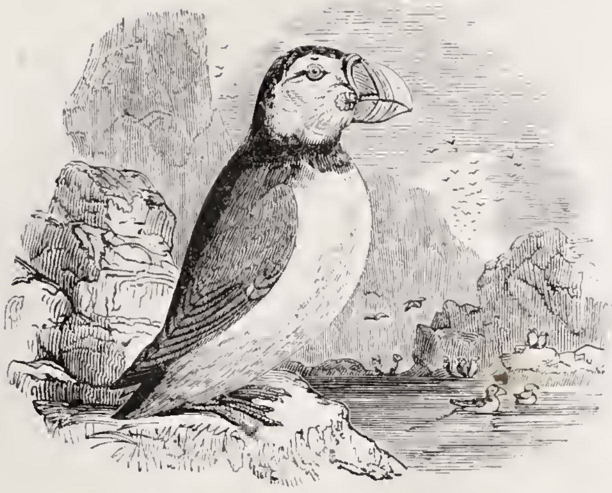
2015.—Eared Grebes.

2016.—Foot of Grebe.

2017.—Head of Grebe.

2018.—Northern Diver.


2029.—Parrakeet Auk.


2025.—Puffin.


2042.—Razor-bill.


2020.—Bill of Guillemot.

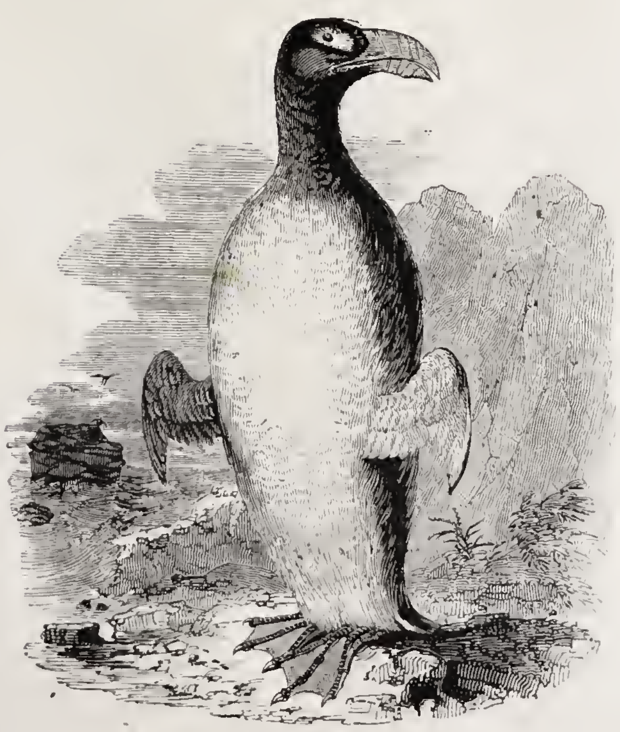

2022.—Black Guillemots.


2021.—Foot of Guillemot.


2028.—Gizzard of Little Auk.


2019.—Foolish Guillemots.


2026.—Puffin.


2023.—Great Auk.


2027.—Little Auk.

Family ALCADÆ (AUKS, GUILLEMOTS, and PUFFINS).

The Alcadæ are equally well adapted for the water as the Colymbidæ: indeed, the power of the wings as organs of flight is more circumscribed, and in one species they are useful only as paddles for assisting in aquatic progression. The legs are extremely short, but powerful, placed posteriorly, so that in resting on the rocks the birds assume an upright attitude, the whole of the tarsus as well as the toes being applied to the surface. The toes are usually only three in number, and fully webbed; when the hind-toe exists it is in a rudimentary condition. The bill varies in form in the different genera; but is generally compressed, and often grooved at the sides. Unlike the Colymbidæ, the Alcadæ are strictly oceanic, never resorting to fresh water. Fishes, crustacea, and other marine productions, constitute their food. They are natives of the northern hemisphere, the Penguins (Spheniscidæ, Bonap.) taking their place in the southern.

2019.—THE FOOLISH GUILLEMOT

(*Uria Troile*). In the genus Uria the bill is moderate, robust, straight, acute, and compressed; nostrils basal; the limbs short, the tarsi alone appearing to emerge from the body; tail very short. Fig. 2020 represents the Bill of the Guillemot; Fig. 2021, the Foot.

The Foolish Guillemot, so called from suffering itself to be taken rather than quit the single egg over which it broods, is found in the Arctic seas of the Old and New World; in winter the immense flocks which have left their breeding places, for they are migratory in their habits, pass along the coasts of Norway and England, Holland, and France, and abound in the Baltic. According to Nuttall, the great body of American birds of this species take their course along the whole coast of Hudson's Bay, Labrador, and Newfoundland, and winter in the Bay of Fundy. In spring the flocks which were scattered over the bays, gulfs, and seas of the temperate latitudes, where food was abundant, return to their old breeding haunts. In our island they make their appearance towards the end of March or the beginning of April, and tenant in myriads the Orkneys, the Bass Rock, the isolated pillars of trap-rock in the Farn Islands, the cliffs of Scarborough, and the needles and cliffs of the Isle of Wight, as well as other places. Here, associated with razor-bills, puffins, and other sea-fowl, they cover the ledges of the precipitous rocks, ranged in tiers; the guillemots in crowded rows, each female sitting in an upright position on her own egg, which she has deposited on the narrow naked ledge; all living in harmony together: the appearance made by the congregated multitude in a dense mass is very curious. Incubation lasts a month; the young, which are at first clad in a thick down, of a blackish grey colour above, white beneath, are plentifully supplied with young herrings, sprats, and other fish, till in the course of five or six weeks they acquire their plumage, and taking to the water, depend upon their own exertions. The egg is of a pale green, stained with black and umber-brown.

In the autumn the guillemots leave the rocks, and betake themselves entirely to the ocean, where the old birds undergo a moult, in which the black of the throat and sides of the neck is exchanged for white, the black being reassumed the following spring. At this time, from the loss of so many of the quill-feathers, they are often for a short time unable to fly; but as they are out at sea, and dive on the approach of danger with astonishing quickness, this is of little consequence. The flocks now gradually pass southwards, following the shoals of fishes which leave our coasts, and at length reach the Mediterranean and the coast of Sicily, where they feast upon the anchovy and sardine. On the other hand, a few stragglers from the polar circle visit the friths of Scotland, which appear to be the extent of their southern migration. The flight of the guillemot is sharp and rapid, at a low degree of elevation, but not of long duration. In its summer dress the head and neck of this bird are black, and the feathers of a velvety texture; the upper surface is sooty black; the under plumage white; bill and legs black. Length fifteen inches.

In the young of the year the black of the upper parts is clouded with ash colour; ashy brown predominates on the lower part of the neck; and the white of the lower parts is not so pure.

2022.—THE BLACK GUILLEMOT

(*Uria Grylle*). The Black Guillemot inhabits the same range of countries as the preceding species, and migrates southwards in winter along the borders of the ocean. It is rare on the English coast, but breeds abundantly in the Orkney and Shetland Isles, on the ledges of the rocks, and according to Selby, Gould, and others, lays a single egg of a greyish white speckled with black and dusky grey. Both Nuttall and Audubon, however, affirm that in the northern districts of America this species lays three eggs. "On several occasions," says the latter observer, "at Labrador some of my party and myself saw several black guillemots sitting on eggs, in the same fissure of a rock, where every bird had three eggs under it." For the reception of these eggs, according to the same authority, the birds raise a sort of nest or fabric of pebbles to the height of two or three inches, in order that the water trickling through the fissures and recesses of the rock may not reach the eggs.

Dr. Richardson states that this species abounds in the Arctic seas and straits from Melville Island down to Hudson's Bay, and remains, though in diminished numbers, during winter in the pools of open water, which occur, even in high latitudes, among the floes of ice. In summer the colour of this species is black, with a white band across the wings. In winter the old birds have the cheeks, throat, and all the under plumage pure white; these parts acquiring at the vernal moult the sooty black which remains during the summer.

2023.—THE GREAT AUK

(*Alca impennis*). The true Auks are strictly oceanic birds, never leaving the water, except for the purpose of incubation. They breed, associated together in vast flocks, on the ledges of precipices, in caverns, and deep fissures. They dive with great ease, and using their wings, pursue their finny prey, deep below the surface, with wonderful rapidity. The young are fed from the crops of the parents, even sometime after they leave their "rocky lair," and swim fearlessly amidst the waves. Awkward as the movements of these birds are on shore, they shuffle along with considerable dispatch. The bill is deep, compressed, and cultrated; the upper mandible arched and hooked; the nostrils are nearly hidden by the feathers of the forehead; the wings short.

In the Great Auk the wings are so reduced as to be incapable of serving the purpose of flight, but they are most efficient paddles, aiding its progress beneath the water. This fine species is a native of the Arctic circle; its visits to the northern islands of Scotland are very rare; Dr. Fleming gives the account of one which was taken alive at St. Kilda in 1822. And one was ineffectually chased by Bullock, during his tour to the northern isles, 1813, who followed in a six-oared boat, and found himself, despite the exertions of the men, completely distanced. It was ultimately shot, allowing the boatmen, to whom it appeared indifferent, to approach within gun range. The one described by Dr. Fleming swam under water with a long and heavy cord tied to its leg, making way with extraordinary rapidity. The great auk is frequent about the coasts of Norway and Iceland, but still more so around the icy shores of Greenland and Spitzbergen, where it breeds in the clefts and caverns of rocks, above the highest tides. The female lays a single egg, as large as that of a swan, of a whitish yellow marked with numerous lines and strokes of black.

Fish and various crustacea constitute the food of this species; its favourite prey is said to be the lump-fish (Cyclopterus lumpus). The great auk measures nearly three feet in length. The upper plumage is deep black, with the exception of a large patch of white on the forehead and around the eyes, and a slight band of white on the wing; under plumage white; bill and legs dull black. In winter the cheeks, throat, fore-part and sides of the neck, are white.

2024.—THE RAZOR-BILL AUK

(*Alca Torda*). In this species the wings are capable of short but rapid flight; they are also used as oars in the water. The Razor-bill is common in the higher latitudes of the northern, and plentiful on the rocky coasts of our island, where it breeds with guillemots and puffins; it tenants the Needles and adjacent cliffs of the Isle of Wight, and the eggs, which are esteemed a delicacy, are taken in great numbers. As the chalk-cliffs there are six hundred feet in elevation, the islanders reach them from above by descending the perpendicular cliffs much in the same perilous manner as is practised by the Norwegians and hardy natives of the Feroe Islands. They drive a large stake, or bar of iron, into the top of the cliff, and to this they fasten a strong rope, with a stick put crosswise at the end, for the support of the adventurer, who is lowered down the front of the horrid precipice. If his object is to secure the eggs only, he shouts to scare away the birds, which rise in countless numbers; but if he wishes to secure the birds, for the sake of the feathers, he goes to work in silence, and either catches them in their holes, or knocks them down with a stick as they fly out: the soft feathers are valuable, and find a ready market; the flesh is worthless, but is used by the fishermen as baits for crab-pots, &c. The same mode is practised in the Isle of Man. On the coast of Labrador thousands of these birds are killed for the sake of the breast-feathers, which are close, warm, and elastic; and the eggs are collected in incredible multitudes. Each female, however, only lays one egg, large in proportion, and pointed, of a yellowish white blotched with dark brown. The razor-bill is fifteen inches long. The head, neck, and upper plumage are black, with a distinct white line from the beak to the eye, and a narrow bar across the wings; under parts white; bill black, with a white band down the sides of each mandible; legs black. In winter the throat and fore-part of the neck are white.

2025, 2026.—THE PUFFIN OR COULTERNEB

(*Mormon Fratercula*, Temm.). Fratercula arctica, Brisson; Alca arctica, Linn.; Mormon arcticus, Illiger.

In this genus the bill is short, nearly as deep as long, and very compressed, the edge of the upper mandible being thin and sharp; the nostrils are slits on the border of the upper mandible near the base; the sides are marked by oblique ridges and furrows, and a loose puckered skin surrounds the corners of the mouth. Two horny appendages are placed on the eyelids; the smaller one above the larger beneath the eye.

In its general form and habits the puffin resembles the guillemot and razor-bill: it has the same thick rounded contour, the same address in the water, and the same rapid flight. The puffin is extensively spread through the Arctic circle, whence it migrates southwards in winter. It is a native of our islands, visiting us from the south about the middle of April, and departing for the coasts of Spain and Italy in August. It is common on various parts of our shores; is numerous at the Needles and cliffs of the Isle of Wight, and upon Priestholm Island, off the coast of Anglesea; many resort to the Farn Islands. In the latter place, according to Mr. Selby, there being no rabbits, the burrows of which it can usurp, it selects such spots as are covered with a stratum of vegetable mould, and digs a burrow for itself in which to incubate. The puffins "commence this operation about the first week of May, and the hole is generally excavated to the depth of three feet, often in a curving direction, and occasionally with two entrances. When engaged in digging, which is principally performed by the males, they are sometimes so intent upon their work as to admit of being taken by the hand; and the same may also be done during incubation. At this period I have frequently obtained specimens by thrusting my arm into the burrow, though at the risk of receiving a bite from the powerful sharp-edged bill of the old bird. At the farther end of this hole the single egg is deposited, which in size nearly equals that of a pullet." On rocky coasts, as the cliffs of the Isle of Wight, the puffin selects the crevices and fissured recesses of the precipice for its breeding retreat. The young are at first covered with blackish down, and in about a month are sufficiently plumed to follow their parents to sea. The puffin is an admirable diver: it may be often seen perched on the ledge of a bold precipice, peering with its keen eyes into the glassy water below,—suddenly, it throws itself headlong into the abyss, cleaving the waves, which sparkle as they close over it. Soon, however, it reappears, laden with a row of sprats, its favourite food, which hang from the bill, their heads being secured between the mandibles; and now, taking a curved sweep upwards, it bears them to its young.

In the puffin, the crown of the head, the upper parts of the body, and a collar round the neck are black; the cheeks pearl-grey; the horny appendages to the eyelids leaden-grey; the bill, deeply furrowed, is bluish grey at the base, the middle being rich orange-red, which deepens into fine red at the tip; legs orange-red. Length thirteen inches. The young have the beak small and smooth, and of a dull yellow; and the general plumage more dusky.

2027.—THE LITTLE AUK

(*Mergulus melanoleucus*, Ray). Uria alle, Temm.; Alca alle, Linn.; Rotch and Sea-Dove, Provincial.

This active little bird is intermediate between the auks and guillemots; the bill is not so long and pointed as in the latter, yet not compressed and furrowed as in the former; it is short, stout, and broader than deep at the base. The Little Auk is a native of the Arctic circle, and is recognised as a winter visitor to the coasts of Scotland: Mr. Selby suggests that a few may perhaps breed upon the extreme rocky islands of the north of that part of our country, but of this we have no definite information; on the coasts of England it is rarely seen, and then only when driven by storms and adverse winds from its northern home. It abounds on the bleak coasts of Greenland and Spitzbergen, and thousands have been seen at Melville Island. When the floes of ice are broken up by the wind, myriads of these birds may be seen riding on the waves,

busily engaged in searching for various marine animals, which are tossed up by the agitated waters. The ocean is its home and resting-place, except during the season of incubation, when it resorts in thousands to the ledges of precipitous rocks, on which the female deposits her single egg, of a pale bluish green. Its flight is rapid, but low, and never long sustained. This species is about nine inches long. The head, back of the neck, and upper plumage are black; under plumage white; a narrow white bar across the wing; the throat, neck, and upper part of the breast pitch-black in summer, more or less white in winter.

Fig. 2028 shows the Gizzard and Proventriculus of this bird laid open: the latter is remarkable for its peculiar form.

2029.—THE PARRAKEET AUK

(*Phaleris Psittacula*). Alca psittacula, Pallas. This species, which has the habits and manners of the preceding, differs in the form of the beak, of which the upper mandible is swollen, and bent at the tip, and the under mandible enlarged, and turned upwards. It is a native of the Arctic circle, and swims and dives with great facility. The female lays a single egg, nearly equalling that of a fowl, of a yellowish white colour with brown spots. The length of this species is about eleven inches. From behind the eye springs a tuft of white feathers, which hang down the side of the neck. General colour above, black, gradually blending into the white of the under parts. It is common on the north-western coast of America.

Family SPHENISCIDÆ (PENGUINS).

The Prince of Canino, in his 'Specchio generale del Sistema Ornitologico,' regards, we think correctly, the penguins as constituting a distinct family. They are birds utterly incapable of flight, having their paddle-wings with short rigid scale-like feathers disposed in regular order; the tarsi are placed so completely behind that in resting the birds assume naturally an upright attitude; the toes are webbed; the tarsi very short and stout. These birds are essentially aquatic, seldom visiting the shore except during the breeding season, and their progress on land is very singular; while swimming they are immersed above the breast. All are natives of the colder seas of the southern hemisphere. The bones, unlike those of birds in general, are hard, compact, and heavy, and have no apertures for the admission of air; those of the extremities containing an oily marrow.

2030, 2031.—THE PATAGONIAN PENGUIN

(*Aptenodytes Patachonica*). King Penguin; le grand Manchot of the French.

This strange bird, which, among its own class, seems to be the analogue of the seals among mammalia, is admirably adapted for oceanic habits. The whole of its osseous and muscular structure, its tough oily skin, and the character of its close and rigid plumage, at once indicate its mode of life. We may here observe that a very elaborate account of the anatomy of the penguin by Mr. Reid will be found in the 'Proceeds. Zool. Soc.' for 1835.

Though often alluded to by voyagers and navigators, the manners and habits of the Patagonian penguin have been very imperfectly understood. Its range of habitation is restricted to the latitudes south of the line, but within this boundary it is widely distributed, being abundant not only in the Straits of Magellan, and on all the adjacent islands, but extending to Australia, through the islands of the South Pacific. If Clusius be right, the first discovery of these birds was by the Dutch, in 1598, who met with them on some islands near Port Desire, to which they came in order to breed; and the sailors called them penguins, or pinguins, and the islands the Penguin Islands. "These singular birds," adds Clusius, "are without wings, having in their place two membranes, which hang down on each side like little arms; their neck is thick and short, their skin hard and tough, like that of a hog; the young weighed ten or twelve pounds, but the old ones about sixteen, and their size was generally that of a goose." Forster, however, measured some thirty-nine inches long and thirty pounds in weight; he remarks, that they were met with in troops on New Georgia, and that such was their stupidity, that they allowed themselves to be approached, so that the sailors knocked them down with sticks. (See 'Second Voyage of Captain Cook,' vol. iv.) Bougainville, who met with them in the Falkland Isles, observes that they love solitary and remote spots; he also well describes their colour, and notices an attempt made to tame one and bring it to Europe, but for want of proper food it became meagre and died. Beyond the facts, however, that they associate in vast bodies, sitting upright on the beach, in close array; that they are destitute of the fear of man, in lonely islands where man had never been before; and that they are incapable of flight, we gain but little positive information from the relations of the earlier navigators. Fortunately, more attention is now directed to natural history than formerly; and several individuals have recorded their personal observations on the habits of the animals met with on their journeys and voyages, to say nothing of naturalists who expressly travelled for the purpose of acquiring knowledge in this department of science. In the 'Zool. Proc.' for 1835 is an account of the penguin, by Mr. G. Bennett, which we shall take the liberty of transcribing. This able naturalist, to whom science is indebted for many original observations, and whose work, entitled 'Wanderings,' &c., is well known, paid much attention to the Patagonian, or king penguin, which he met with in various islands in the high southern latitudes; and he describes particularly a colony of these birds, which covers an extent of thirty or forty acres at the north end of Macquarrie Island, in the South Pacific Ocean.

"The number of penguins collected together in this spot is immense, but it would be almost impossible to guess at it with any near approach to truth, as, during the whole of the day and night, thirty or forty thousand of them are continually landing, and an equal number going to sea. They are arranged, when on shore, in as compact a manner and in as regular ranks as a regiment of soldiers; and are classed with the greatest order, the young birds being in one situation, the moulting birds in another, the sitting hens in a third, the clean birds in a fourth, &c.; and so strictly do birds in similar condition congregate, that should a bird that is moulting intrude itself among those which are clean, it is immediately ejected from among them.

"The females hatch the eggs by keeping them close between their thighs; and if approached during the time of incubation, move away, carrying the eggs with them. At this time the male bird goes to sea and collects food for the female, which becomes very fat. After the young is hatched, both parents go to sea, and bring home food for it; it soon becomes so fat as scarcely to be able to walk, the old birds getting very thin. They sit quite upright in their roosting-places, and walk in the erect position until they arrive at the beach, when they throw themselves on their breasts in order to encounter the very heavy sea met with at their landing-place."

Although the appearance of penguins generally indicates the neighbourhood of land, Mr. G. Bennett cited several instances of their occurrence at a considerable distance from any known land.

The observations of Mr. Bennett are confirmed by Lieut. Liardet, from whom was obtained the specimen dissected by Mr. Reid.* They assemble on the shore, herd together in vast bodies, forming a dense phalanx, all moving and acting in concert together; one party going off to sea,—another party returning,—another remaining in array on the beach. They appear to be very peaceable among each other, but are sometimes observed to fight, striking with the posterior edge of the wing. Should a person attempt to lay hold of them, they not only use their wings but their beak, which is a far more formidable weapon, and capable of inflicting a severe wound. Cuttle-fishes appear to constitute the greater part of their food; in the stomach of the specimen dissected was found a considerable number of the horny parrot-like beaks of these molluscous animals. Their mode of walking is very singular; it is a sort of awkward waddle, the body turning with the action of the limbs in motion, which cross each other alternately; it is, in fact, an "over-handed" mode of progression, if the word be allowed, producing a strange and ludicrous effect. We see a tendency to it in the waddle of the duck and other swimming-birds. During the period of incubation the females all assemble together, sitting upright on a kind of general nest, of loosely-arranged sticks, which they carry to the selected spot in their bills, and flourish if then approached, as if in defiance of the intruder on their secluded haunt. They lay but one egg, of a whitish colour, and twice the size of that of the goose; this they carry between their thighs, supporting it beneath by the short stiff tail, which is bent underneath it. The young are covered with thick soft down, of a brownish grey; in this state the bird is the woolly penguin of Latham, which must not be regarded as a distinct species, but as the king penguin in nestling plumage. At night they utter loud moaning noises in concert, the general chorus of voices resounding to a great distance, and clearly distinguishable from the roar of the surf or lashing of the waves. The flesh of the penguin is rank, and unfit for food; both the muscles and bones are oily, and the skin is lined with a thick layer of oleaginous fat; yet more than five hundred were taken in New Year's Island (near Staaten Island), as food for the crew, by the sailors in Captain Cook's ship ('Last Voyage,' vol. i.), who found them occupying that spot in thousands.

There is something in the strange figure and aspect of the penguin well agreeing with the wild, lonely, remote islands in which it congregates. In beholding a spot on the surface of our globe, ocean-girt, and uninhabited by man, tenanted by thousands of these birds, which for ages—generation after generation—have been the uninterrupted occupiers of the place, we are thrown back upon primeval days; and we involuntarily recur to the now extinct dodo, and the idea forces itself upon us, that this bird also may, at some future time, become utterly annihilated.

The general plumage of the penguin is short, close, glossy, compact, and water-proof; the bill is long, slender, and somewhat bent at the tip; a longitudinal furrow runs along each side of the upper mandible, down which the feathers of the forehead proceed to a considerable distance, entirely concealing the nostrils. The feet consist of three toes, with intervening webs, but a fourth rudimentary toe is seated above the base of the first or inner toe on each foot. The eye is small, viewed externally; but its globe is really large, and it is furnished with a strong membrana nictitans.

The height of this species is upwards of three feet; its colours are beautifully disposed and contrasted. The bill is black, except the base of the under mandible, which is rich reddish purple, with a plum-like bloom, gradually merging into dusky and ultimately into black; the top of the head and throat are black, bounded by a belt of fine pure golden yellow, which commences broad on the sides of the head, and becomes narrow in its progress as it runs down to the middle of the neck, where it passes onwards till it blends with the silvery white of the under surface; the colour of the upper surface of the body and paddles is glossy bluish grey; each feather, if examined, being dusky black margined with bluish grey, and it is from the overlapping of the feathers on each other that one uniform tint is produced; the tail, which is short, and indeed can scarcely be called a tail, consists of slender stiff elastic feathers, bent under the bird, as it sits up on the shore.

Fig. 2032 represents the Head, and Fig. 2033 the Foot of the King Penguin.

2034.—THE CRESTED PENGUIN

(*Eudyptes chrysocoma*, Vieillot). Catarrhactes chrysocoma, Brisson; Aptenodytes chrysocoma, Gmelin.

This beautiful species inhabits the Falkland Islands, the shores of Patagonia, the island of Tristan d'Acunha, and is often found far out at sea, swimming in pairs. Lesson killed individuals in 43° 8′ 38″ S. lat., and 56° 56′ 49″ W. long. It has obtained the name of jumping penguin, from its habit of leaping quite out of the water, not only in order to avoid obstacles, but apparently as if for sport. It is le Gorfou sauteur of Cuvier.

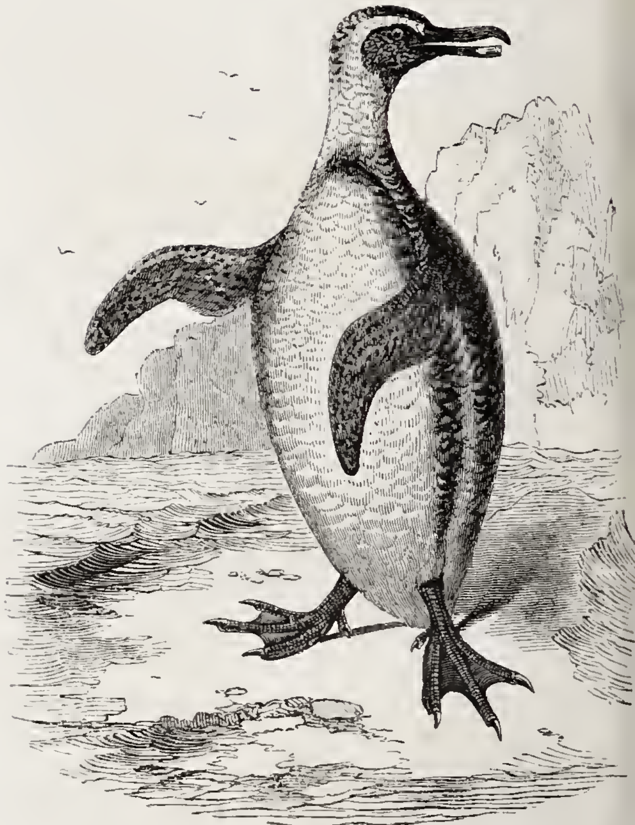
The crested penguin, says Latham, "appears to be more lively than the others, but, in fact, they are stupid birds, so as to admit of being knocked down with sticks when on land, and are frequently so regardless as to suffer themselves to be taken by the hand. When enraged they erect their crests in a very beautiful manner. They make their nests among those of the pelican tribe, living in tolerable harmony with them." "They are, however, mostly seen by themselves, seldom mixing with other penguins, and are often met with on the outer shores where they have been bred. The females incubate in burrows, which they easily form by means of their bill, throwing out the earth with their feet; in these holes the egg is deposited on the bare ground." "We learn, from the 'Embassy to China,' that these birds were found in vast abundance in the island of Amsterdam, often basking and standing erect in company with the seals." Captain Carmichael, in his description of the island of Tristan d'Acunha, states, respecting this species, that it "conceals itself among the long grass, and in the bottom of ravines where they open upon the shore. Here these birds assemble in countless multitudes, and keep up a moaning noise, which can be heard at a great distance from the mountain." He adds that "in many birds I had an opportunity of examining the pupil was contracted to a mere dot." ('Linn. Trans.' v. 12.)

The crested penguin is twenty-three inches in length; the bill is red, with a dark furrow running on each side to the tip; the upper mandible, three inches in length, is curved at the end; the head, neck, back, sides, and wings externally are black; the whole of the under surface is white; over each eye runs a stripe of pale golden yellow feathers, which lengthen behind into a pendent crest nearly four inches long, and can be erected at pleasure; the feathers on each side of the head above this crest are longer than the others, and stand upwards; the female has a yellow streak above each eye, but the crest is not developed; legs orange-coloured.

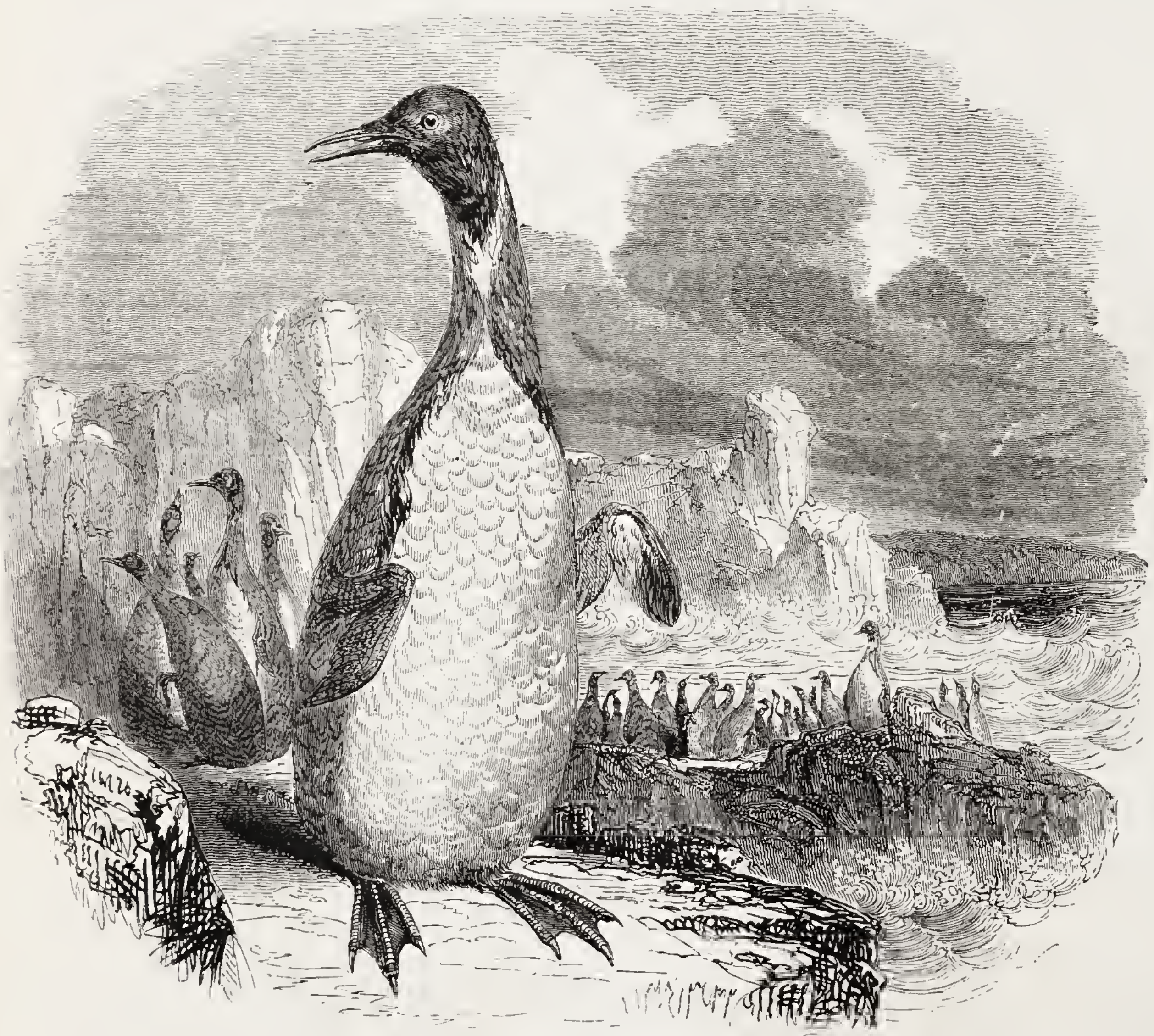
* This specimen was captured at East Falkland Isle, in latitude 51° 32′ south.

2030.—Patagonian Penguin.

2032.—Head of King Penguin.



2035.—Jackass Penguin.



2031.—Patagonian Penguins.

2034.—Crested Penguin.

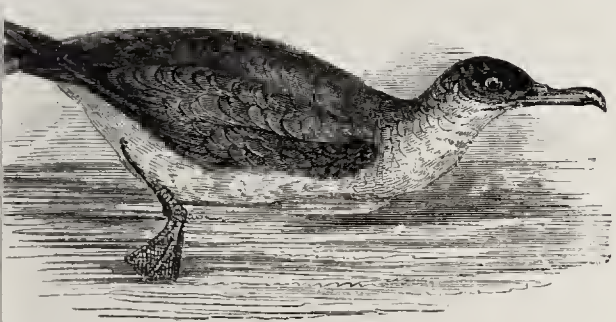
2036.—Grebe Petrel.

2033.—Foot of King Penguin.


2040.—Pintado Petrel.

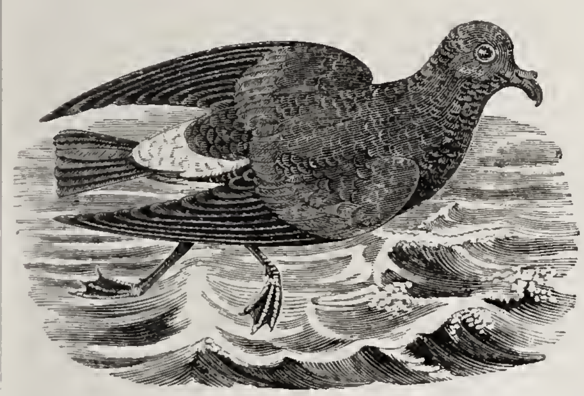

2038.—Head and Foot of Fulmar.

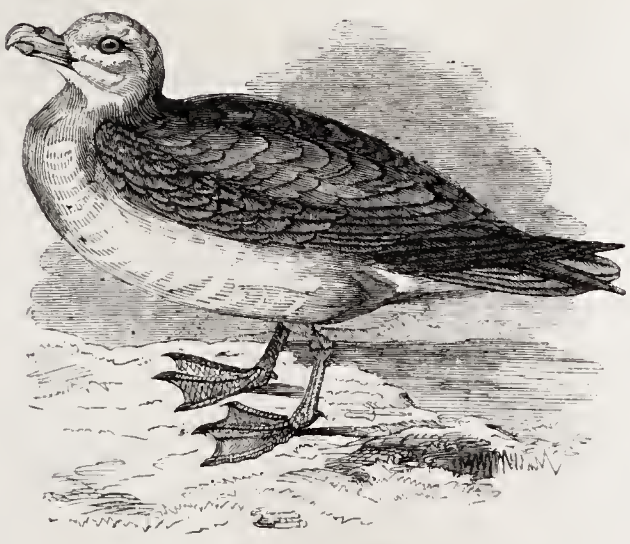

2046.—Albatross.


2041.—Manks Shearwater.


2043.—Head and Foot of Stormy Petrel.


2045.—Blue Petrel.


042.—Stormy Petrel.


2037.—Fulmar Petrel.


203).—Great Black Petrel.


2044.—Wilson's Petrel.

2035.—THE JACKASS PENGUIN

(*Spheniscus demersus*). This species inhabits the same extent of range as the two preceding, and is very abundant at the Falkland Islands, and the Cape of Good Hope. Captain Fitz-Roy observed it in great abundance at Noir Island. "Multitudes of penguins," he observes, "were swarming together in some parts of the island, among the bushes and 'tussoc' (thick rushy grass) near the shore, having gone there for the purposes of moulting and rearing their young. They were very valiant in self-defence, and ran open-mouthed, by dozens, at any one who invaded their territory, little knowing how soon a stick would scatter them on the ground. The young were good eating, but the others proved to be black and tough when cooked. The manner in which they feed their young is curious and rather amusing. The old bird gets on a little eminence, and makes a great noise (between quacking and braying), holding its head up in the air, as if it were haranguing the penguinnery, while the young one stands close to it, but a little lower. The old bird, having continued its clatter for about a minute, puts its head down and open its mouth widely, into which the young one thrusts its head, and then appears to suck from the throat of its mother for a minute or two, after which the clatter is repeated, and the young one is again fed; this continues for about ten minutes. I observed some which were moulting make the same noise, and then apparently swallow what they thus supplied themselves with; so in this way, I suppose, they are furnished with subsistence during the time they cannot seek it in the water." ('Voyages of the Adventure and Beagle,' King.)

Mr. Darwin, who found this bird at the Falkland Islands, gives the following interesting account of its courage and habits. "One day," he says, "having placed myself between a penguin (Aptenodytes demersa) and the water, I was much amused by watching its habits. It was a brave bird; and, till reaching the sea, it regularly fought and drove me backwards. Nothing less than heavy blows would have stopped him; every inch gained he firmly kept, standing close before me, erect and determined. When thus opposed, he continually rolled his head from side to side, in a very odd manner, as if the power of vision only lay in the anterior and basal part of each eye. This bird is commonly called the jackass penguin, from its habit, while on shore, of throwing its head backwards, and making a loud strange noise, very like the braying of that animal; but while at sea and undisturbed, its note is very deep and solemn, and is often heard in the night time. In diving, its little plumeless wings are used as fins; but on the land, as front legs. When crawling (it may be said on four legs) through the tussocks, or on the side of a grassy cliff, it moved so very quickly that it might readily have been mistaken for a quadruped. When at sea, and fishing, it comes to the surface, for the purpose of breathing, with such a spring, and dives again so instantaneously, that I defy any one at first sight to be sure that it is not a fish leaping for sport." ('Voyages of the Adventure and Beagle;' Darwin, 'Researches in Geology and Natural History.')

In this species the bill is compressed, straight, and irregularly furrowed at the base; the end of the upper mandible is hooked, that of the lower truncate. The upper surface, cheeks, and throat, black; the under parts, and a stripe above the eye, white; a black mark commencing on the chest runs along each side.

Other smaller species are known, of which one is found in thousands on the shores of Australia: it lays two eggs.

Family PROCELLARIDÆ (PUFFINS, PETRELS, &c.).

Well known to seamen are these birds, which appear in multitudes far from land, wheeling and skimming over the rolling billows of the ocean, on the surface of which they rest when wearied, and from which they derive their subsistence. With the appearance of some, superstition has associated storms and shipwreck, and many a weather-beaten tar, who feared no mortal foe, has quailed at the ominous presence of Mother Carey's chickens, which seemed to have sprung at once from out of the deep.

In these birds the upper mandible, which is furrowed into distinct segments, terminates in an arched and abruptly hooked nail, or dertrum, and the under mandible terminates also in a sort of hard distinct nail. The nostrils are more or less decidedly tubular, and sometimes the tubes are united together. The anterior toes are webbed; the hind-toe is either wanting or rudimentary. The flight very buoyant. Many species eject a quantity of oil from the nostrils with considerable force, and this is their usual, and perhaps only, mode of defence. Their bodies are, as it were, saturated with oil, from the nature of the food on which they subsist.

2036.—THE GREBE PETREL

(*Pelecanoides urinatrix*, Lacépède). Haladroma urinatrix, Illiger; Procellaria urinatrix, Gmelin; Puffinura Garnoti, Lesson.

In this genus, as in Procellaria, the bill is composed of distinct pieces soldered together; the nostrils are tubular, separated from each other by a simple partition, and open above. Wings pointed; tail small. Tarsi moderate; hind-toe wanting.

This species abounds in flocks on the coast of Peru, where it was seen by M. Garnot. It flies moderately well, skimming the waves in a precipitous manner, but prefers to rest on the surface, and like the grebes, or puffins, dives admirably in search of its prey, which consists of small fishes and crustacea. In length this bird measures about nine inches; the upper surface is blackish brown, with a slight glaze of blue on the top of the back; the throat and chest are of a lustrous white; the sides are greyish white. We have no accounts of its nidification.

2037.—THE FULMAR PETREL

(*Procellaria glacialis*). Fulmarius glacialis, Leach; le Pétrel fulmar, ou de l'Isle de St. Kilda, of Buffon; Gwylan y Graig of the ancient British.

The character of the head and foot of the genus Procellaria, or subgenus Fulmarius of Leach, are well depicted in Fig. 2038. The nostrils are tubular, the tube being elevated and opening by a single rounded orifice; the tip is greatly hooked. A sharp claw exists in the place of a hind-toe.

The Fulmar Petrel is a native of the Arctic regions, and abounds at all times in Davis's Straits and Baffin's Bay. It is, however, migratory, and Major Sabine states that during the time of the detention of the ships by ice in Jacob's Bay, lat 71°, from the 24th of June to the 3rd of July, fulmars were passing in a continual stream to the northward, in numbers inferior only to the flocks of the Passenger Pigeon in North America. In more southern latitudes the fulmar is only seen as a winter visitor, extending its journey along the coast of Norway, and appearing occasionally on those of Holland and France; yet there are certain spots within the limits of the British Islands where it breeds in great abundance, namely, the rocky and precipitous St. Kilda, and others of the western isles of Scotland; and, according to Mr. Gould, it also resorts to the Orkneys, &c., though St. Kilda is its favourite residence. Here the fulmars take up their abode in the holes and caverns of the rocks. The female lays a single large white, and very brittle, egg; and the young, which are hatched in June, are fed with oil disgorged by the parents. These birds constitute a source of emolument to the inhabitants. As soon as the young are fledged, the cragsmen, at the risk of their lives, scale the precipitous cliffs, and capture them in great numbers for the sake of the down, feathers, and oil. "No bird," says Pennant, "is of such use to the islanders as this: the fulmar supplies them with oil for their lamps, down for their beds, a delicacy for their table, a balm for their wounds, and a medicine for their distempers. The fulmar is also a certain prognostication of the change of wind; for if it comes to land no west wind is expected for some time, and the contrary when it returns and keeps the sea."

The food of this species consists of the flesh and blubber of dead whales, seals, and fishes, mollusks, and crustacea. According to Captain James Ross these birds are of great importance to the whale-fishers, by guiding them to those places where the whales are most numerous; and they give notice of the first appearance of these animals at the surface of the water, by crowding to the spot from all quarters. They have been seen in multitudes on the floating carcass of these giants of the ocean, tearing up the skin with their hooked beaks, and gorging on the delicious blubber. Off Newfoundland the fulmar is a constant attendant upon the fishing vessels, in order to obtain the livers and offal of the cod-fish.

The fulmar measures sixteen inches in length. The head, neck, all the lower parts, rump, and tail, are pure white. Back and wings bluish ash; quills bright blackish grey. Bill yellow; legs yellow, tinged with grey. The young have the white tinged with ash colour, and the upper plumage brownish.

2039.—THE GREAT BLACK PETREL

(*Procellaria æquinoctialis*). P. gigantea, Gmelin.

This species tenants the southern seas, and, according to Mr. Darwin, is a common bird both in the inland channels of the Chonos Archipelago (off the west coast of Patagonia south of Chiloe Island), and out in the open ocean. It is termed by the Spaniards Quebrantahuesos, or Break-bones, the name for the osprey, and in its habits and manner of flight it closely resembles the albatross. "As with the latter bird a person may watch it for hours without seeing on what it feeds." "The Break-bones, however, is a rapacious bird, for it was observed by some of the officers at Port St. Antonio chasing a diver; the bird tried to escape both by diving and flying, and was at last killed by a blow on its head. At Port St. Julian also these great petrels were seen killing and devouring young gulls." The plumage of this species is blackish.

2040.—THE PINTADO PETREL, OR CAPE PIGEON'

(*Daption Capensis*). Procellaria Capensis, Linn.

This species is spread over the whole of the southern hemisphere. "From the meridian of the island of Tristan d'Acunha, to that of the island of St. Paul's," says Captain King, "on about the parallel of 40° south latitude, we were daily surrounded by a multitude of oceanic birds: of the Petrel tribe the Cape Pigeon (Pr. Capensis, Linn.) was most abundant; but the Proc. vittata (vel cœrulea) frequently was observed, as was also a small black petrel, which I do not recollect to have seen before." ('Proc. Zool. Soc.' 1834, p. 128.) In its habits this species resembles the rest of its race. Its plumage is variegated with brown and white. Total length about thirteen inches; that of the tube of the nostrils half an inch.

2041.—THE MANKS SHEARWATER

(*Puffinus Anglorum*). Shearwater; Shearwater Petrel. The genus Puffinus is characterized by the length and slenderness of the bill, and by the tubular nostrils having two distinct truncated openings. The wings are long. Hind-toe represented by a straight nail.

The Manks Shearwater in the time of Willughby and Pennant was abundant in the Isle of Man, or rather on that islet termed the Calf of Man, at the south end of the island, and divided from it by a narrow channel. In the present day it is almost entirely deserted by these birds, which still resort to the Orkneys, arriving in February or March, and leaving with their young in August for the coast of Spain, the Mediterranean, &c. They breed in holes scratched in the earth, among outcropping rocks, on bold headlands; and also make use of deserted rabbit burrows, and deep crevices in the rocks. The female lays a single white egg of a rounded form. During the day the shearwaters remain quiet in their burrows, whence they emerge when evening twilight approaches, and, sailing out to sea, procure food for themselves and their young. They feed on all kinds of marine animal substances in a state of decomposition, and of an oleaginous quality, and nourish their young by disgorging oil into their throat. When captured they annoy their assailant by ejecting quantities of oil from their tubular nostrils.

According to Mr. Gould the shearwater is abundant during the summer on the coast of South Wales, whence he received on one occasion four dozens, all apparently captured by the hand. It is rare in Norway, but common on the banks of Newfoundland.

The shearwater flies rapidly, skimming over the surface of the sea, whence it picks up whatever offers for food. While thus engaged it uses its feet as a support on the water, and while skimming along strikes the water with them, to aid the impetus required for cutting through the curling crests of the waves. The limbs have a very backward position.

Formerly thousands of the young of this species were taken in the Calf of Man, for the purpose of supplying the table; they were salted and barrelled, but the flesh was rank and fishy. The feathers were valued. In the Orkneys, according to Low, it is the main object of pursuit with the rock-men, who endanger their lives in climbing the most awful precipices for the eggs and young of the sea-fowl. Pennant states that in his time they were salted in these islands for winter provision, and boiled with cabbage. The manks shearwater is about thirteen inches long. All the upper parts are glossy black; the lower parts pure white. Bill blackish brown; legs brown; webs yellowish. The tarsi, as in the true petrels, are very much compressed, a form which, doubtless, greatly facilitates their practice of half running along, half flying over, the surface of the waves while in quest of food.

2042.—THE STORMY PETREL

(*Thalassidroma pelagica*). Pétrel Tempête, Temminck: Kleinster Sturmvogel, of Meyer; Accello delle Tempeste, of the Italians; Cas gan Longwr, of the ancient British; Mother Carey's Chicken, Stormfinch, Spency, Mitty, Witch, &c., of the English.

In the genus Thalassidroma the bill is rather short, compressed, and hooked in front of the tubular nostrils; the wings are long and pointed; the tarsi are rather long, slender, and compressed; the hind-toe is reduced to a minute nail. The Stormy Petrels are the smallest of the web-footed race of birds, and are distributed over every part of the ocean.

The present species is found along the coasts of North America, and is also common along the coasts of Scotland and England; it is rather abundant in the Orkneys and Hebrides. Mr. Selby states that it is to be seen upon the seas surrounding Great Britain at all seasons of the year, but he doubts the very extensive range some writers have assigned it, other closely allied species having been mistaken for it; and in this view he is confirmed by Mr. Gould, who in a letter to the Zool. Soc., dated Van Diemen's Land, May 10, 1839 (see 'Proceeds.' 1839), relating some details relative to several oceanic birds met with during his voyage, says, "Immediately off the Land's End Wilson's storm-petrel (Th. Wilsonii) was seen in abundance, and continued to accompany the ship throughout the bay. The little storm-petrel (Th. pelagica) was also seen, but in far less numbers; both species disappeared on approaching the latitude of Madeira, their place there being occupied by another species, which I took to be Thal. Bulweri. . . . . As I had every reason to expect, I found the Australian seas inhabited by their own peculiar storm-petrels, four distinct species of which I have already observed since leaving the Cape."

The flight of the petrel is very swift, and on wings even more rapid than those of the swallow, it wheels round the labouring ship, descends into the trough of the waves, and mounts over their curling crests, secure amidst the strife of waters; often, with wings expanded, is it seen to stand, as it were, on the summit of the billow and dip its bill into the water, no doubt in order to pick up some small crustaceous animal; and again, on vigorous wings, it pursues its way. Seldom does it settle on the waters to swim, and it is totally incapable of diving, as many have erroneously supposed. During a gale at sea the petrel is all animation.

"Up and down, up and down,
From the base of the wave to the billow's crown,
Amidst the flashing and feathery foam
The Stormy Petrel finds a home;
A home, if such a place can be
For her who lives on the wide, wide sea,
On the craggy ice, in the frozen air;
And only seeketh her rocky lair
To warm her young, and teach them spring
At once o'er the waves on their stormy wing."

B. CORNWALL.

We agree with Mr. Selby that the great motives which induce the petrel and other sea birds to follow a ship in its course, are the refuse which is thrown from time to time overboard, and the abundance of small marine insects, mollusks, &c., which are brought within its reach by the action of the vessel as it 'ploughs the briny waves. The stormy petrel breeds in the northern and western isles of Scotland, and on the rocky coast of Cornwall: it incubates on a single egg (perhaps two eggs) of a pure white, in the holes of rocks, in the burrows of rats or rabbits, and under large stones. The female utters a low purring noise while brooding over her egg or young. The latter remains in its retreat for some weeks, till fully feathered and capable of flight, and during this time is fed by the parents with oily matter ejected from their stomachs. Though the petrel is seen out at sea, particularly in gloomy weather, when the lowering clouds threaten a storm, yet it is to a great degree nocturnal in its habits, especially during the time of incubation and of rearing its young. Till evening sets in it remains quiet in its retreat, and then sallies forth, making a shrill whistling, as well as the purring noise before alluded to. So oily is the body of the petrel, that the inhabitants of the Ferroe and other islands sometimes convert it into a lamp by drawing a wick of cotton through the body, which will continue to burn till the oil be exhausted.

The length of this species is about five and a half inches; the general colour is sooty black; tail and quills pure black; a patch behind the thighs, and a bar across the upper tail coverts, white; a few of the wing coverts and scapularies slightly edged with white. Fig. 2043 displays the characters of the Head and Feet of Thalassidroma.

2044.—WILSON'S PETREL

(*Thalassidroma Wilsonii*, Bonap.). This species, which exceeds the preceding in size, measuring six and a quarter inches, is, as we learn from Mr. Gould's observations, abundant off the coast of Cornwall; it is common along the whole of America to Cape Horn; and particularly so on the coasts of Chili, Brazil, and the United States. It is said by Temminck to occur but rarely at the Cape of Good Hope, and to show itself accidentally off the coasts of Spain and in the Mediterranean. According to Nuttall this species breeds in great numbers on the rocky shores of the Bahama and the Bermuda islands, and along some parts of the coast of East Florida and Cuba; and, on the authority of Audubon, on the mud and sand islands off Cape Sable in Nova Scotia, burrowing downwards from the surface to the depth of a foot or more. In other places they make the holes and fissures of rocks their retreat. The eggs are three and of translucent whiteness. The habits of Wilson's Petrel are the same as those of its tribe in general.

"On the edge of soundings," says Nuttall ('Manual'), "as the vessel loses sight of the headlands, flocks of these dark, swift flying, and ominous birds begin to shoot around the vessel, and finally take their station in her foaming wake. In this situation, as humble dependants, they follow for their pittance of fare, constantly and keenly watching the agitated surge for floating mollusca, and are extremely gratified with any fat kind of animal matter thrown overboard, which they instantly discover, however small the morsel, or mountainous and foaming the raging wave on which it may happen to float. On making such discovery, they suddenly stop in their airy and swallow-like flight, and whirl instantly down to the waters. Sometimes nine or ten thus crowd together like a flock of chickens scrambling for the same morsel; at the same time pattering on the water with their feet, as if walking on the surface, they balance themselves with gently fluttering and outspread wings, and often dip down their heads to collect the sinking object in pursuit. On other occasions, as if seeking relief from their almost perpetual exercise of flight, they jerk and hop widely over the water, rebounding as their feet touch the surface with great agility and alertness. There is something cheerful and amusing in the sight of these little voyaging flocks, steadily following after the vessel, so light and unconcerned across the dreary ocean. During a gale it is truly interesting to witness their intrepidity and address. Unappalled by the storm that strikes terror into the breast of the mariner, they are seen coursing wildly and rapidly over the waves, descending their sides, then mounting with the breaking surge which threatens to burst over their heads, sweeping through the hollow waves as in a sheltered valley, and again mounting with the rising billow, they trip and jerk sportively and securely on the roughest sea, defying the horrors of the storm, and, like magic beings, seem to take delight in braving overwhelming dangers."

2045.—THE BLUE PETREL

(*Prion vittatus*). Procellaria vittata, and cœrulea, Gmelin; Pachyptila vittata, Illiger.

In this genus the bill is strong, stout, and wide, and much depressed; the upper mandible hooked; nostrils two short united tubes, the edges of the mandible furnished internally with minute cartilaginous laminæ; a guttural pouch between the two branches of the lower jaw; wings long and pointed; a minute nail in the place of the hind-toe. The tongue is thick; the mouth dilatable.

The Blue Petrel was first discovered by Forster. During the voyage of the Coquille many were captured in 58° S. lat. The habits of this bird much resemble those of the petrels and shearwaters. Mr. Gould notices it among the troops of sea-fowl which followed his vessel for some thousands of miles, and of which he says, "Until I had ascertained that they were nocturnal, it was a matter of surprise to me how the birds which were seen around the vessel at nightfall were to be observed crossing our wake at daybreak on the following morning, the ship having frequently run a distance of nearly one hundred miles during the night."

The total length of this species is about twelve inches; the upper surface is ashy blue; a black band cuts across the wings and tail-coverts; under parts white.

2046.—THE ALBATROSS

(*Diomedea exulans*). In the genus Diomedea the beak is large and powerful, with a concave sweep from the base, and rising again towards the point, which is boldly and abruptly hooked; a furrow runs on each side of the upper mandible from the base to the cutting edge of the terminal hook; in these lateral furrows are the nostrils, standing out in the form of short tubes of horn directed obliquely upwards; they are nearly basal and widely separated from each other. Toes, three before, and webbed, none behind. Wings extremely long and narrow.

Several species of albatross are well known and described, but none equal in size the great wandering albatross (Diomedea exulans), which often weighs upwards of twenty pounds, and ordinarily measures from ten to eleven feet, and sometimes even fourteen feet, in the expanse of its wing. It is not until the voyager passes the line, and enters within the latitudes of the southern seas, that he finds himself within the range of the albatross, which on outspread wings sails around the vessel, or sweeps over the surface in chase of the flying-fish, which the bonito or albacore are impetuously pursuing below. These birds are extremely voracious, they will swallow a fish of four or five pounds weight; they feed also on mollusks, blubber, and the offal thrown overboard of vessels. The vast extent of wing which the albatross possesses renders it a matter of some difficulty for this bird to raise itself from the surface of the water on which it is reposing; it has to skim half flying, half running, for a considerable distance before it can fairly mount, but once on the wing it sweeps majestically through the air on expanded pinions, and wheels around in large circles, watching the waters beneath; suddenly it plunges down amidst the billows, covered with their dashing spray, and rises again; and though "the stormy winds may blow," makes its way as if unaffected by the tempest.

Though, as we have said, it is in the southern hemisphere that the albatross abounds, yet it would appear that the European coasts are occasionally visited by this bird, and that in the northern latitudes it is even abundant. Vast flocks of the albatross are seen towards the end of June about Behring's Straits, and Kamtschatka, frequenting chiefly the inner sea, the Kurile Islands, and the bay of Pentschinensi; they are doubtless attracted thither by the enormous shoals of fish, the migratory movements of which they follow. The natives of Kamtschatka catch these birds by means of a hook attached to a cord, and baited with a fish, which they greedily swallow: the intestines are blown, and used as buoys for nets, and the long, hollow wing-bones as tobacco-pipes; the flesh is tough and dry.

Mr. G. Bennett, in his 'Wanderings,' gives an admirable account of the habits of the albatross, far too long for insertion: "It is pleasing," he says, "to observe this superb bird sailing in the air in graceful and elegant movements, seemingly excited by some invisible power, for there is rarely any movement of the wings seen, after the first and frequent impulses given, when the creature elevates itself in the air; it rises and falls as if some concealed power guided its various motions, without any muscular exertion of its own; and then descending, it sweeps close to the stern of the ship, as if it were monarch of all it surveyed. It is from the very little muscular exertion used by these birds, that they are capable of sustaining such long flights without repose." Captain Grey, in his Journal (vol. i. p. 32), gives a nearly similar account of the "lordly and graceful albatross," that holds "its holiday in the stormy gale."

Captain Carmichael ('Linn. Trans.' vol. xii.) found the great albatross and three other species breeding at Tristan d'Acunha; the great albatross raises no nest, but merely selects some slight concavity for the reception of a single large white egg. It nourishes its young by disgorging the oily contents of its stomach, and when approached discharges through the nostrils a deluge of fetid oily fluid on the intruder, at the same time clattering with its beak; otherwise it makes no defence, and is so fearless, as not even to move out of the way for the passage of a party of men, and when pulled off the nest, will either remain quietly by, or instantly return to its egg. Some of the other species raise a nest of mud.

The plumage of the great albatross is subject to variation; the head, neck, back, and wings are generally more or less tinged with grey; the rest of the plumage white; the bill is pale horn colour with a tinge of yellow; feet deep flesh colour.

Family LARIDÆ (GULLS, TERNS, &c.).

These are for the most part oceanic birds, distinguished by great powers of flight. They rest upon the waters, and plunge amidst the curling waves in pursuit of their prey, but do not dive.

2047, 2048.—THE COMMON TERN

(*Sterna Hirundo*). Pierre Garin of the French; Fionco and Rondine di marc of the Italians; Meerschwalbe of the Germans; y Fôrwennol fwyaf, and Yscraen of the ancient British; Sea Swallow, English.

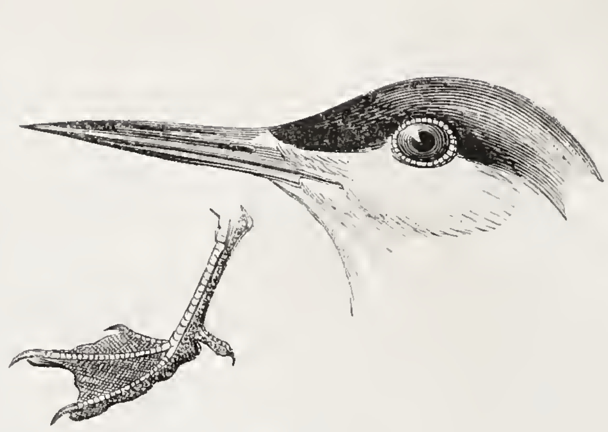
In the genus Sterna the bill is long, compressed, and pointed; the wings are extremely elongated and acuminate; the three anterior toes are moderately webbed, the hind-toe is free; tail forked.

Fig. 2049 represents the Head and Foot of Sterna.

Formed for rapid and protracted flight, these birds skim over the waves with extraordinary speed, whence the English name sea-swallows, and that of the French hirondelles de mer.

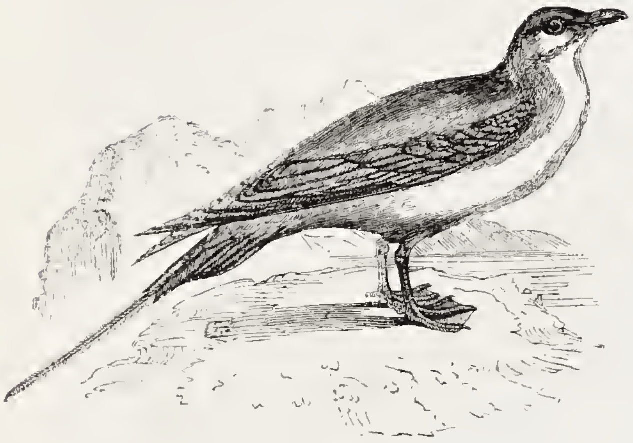
The common tern is found in abundance along our southern shores, and those of the adjacent parts of the Continent, as well as of Asia and Africa; according both to M. Temminck and the Prince of Musignano, it extends its range to the coasts of North America. It flies in flocks, uttering a harsh note, and often ascends creeks and rivers to a considerable distance from the sea. Nothing can exceed the address and suddenness with which this bird darts upon such fish as approach the surface, precipitating upon its unwary victims with unerring certainty, and rising again to pursue its course, as if unchecked by the effort. This species breeds upon

2051.—Scissors-bill.



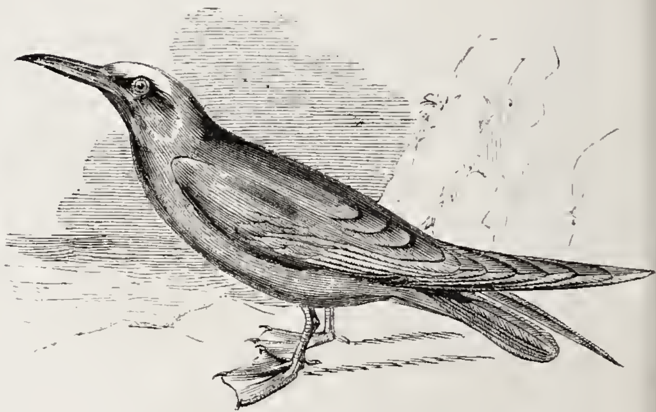
2049.—Head and Foot of Tern.

2047.—Common Tern.

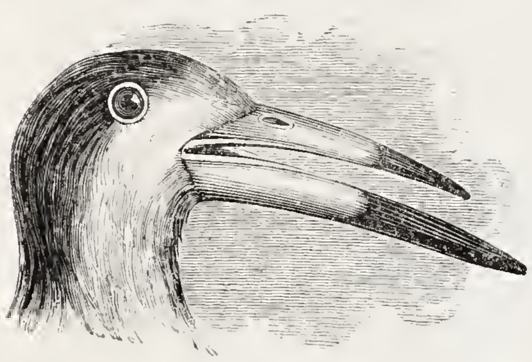


2058.—Arctic Skua Gull.

2052.—Head of Scissors-bill.



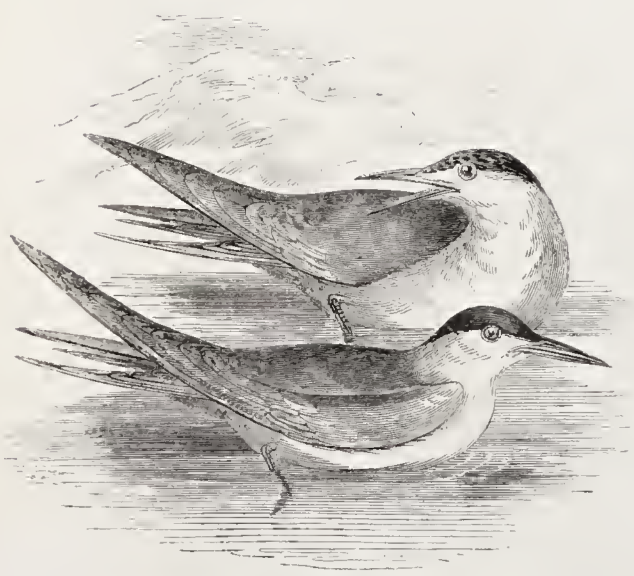
2050.—Noddy.



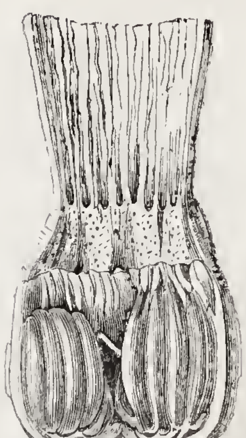
2054.—Head of Scissors-bill.

2053.—Bill of Scissors-bill.

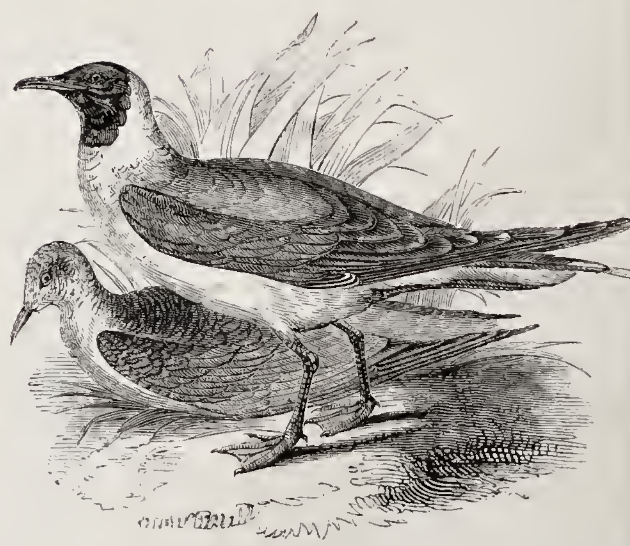
2055.—Great Black-backed Gull.



2048.—Common Terns.



2056.—Gizzard of Sea-Mew.



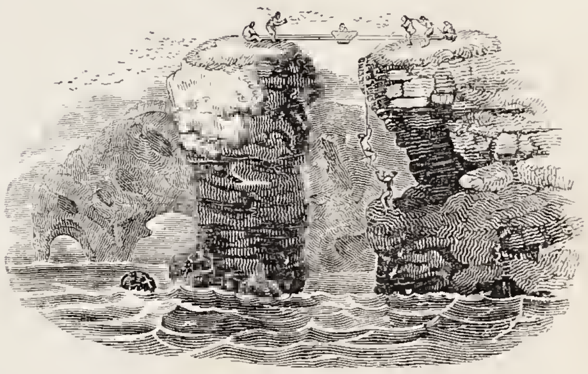
2057.—Laughing Gulls.

2060.—Gannet.

2059.—Tropic Bird.

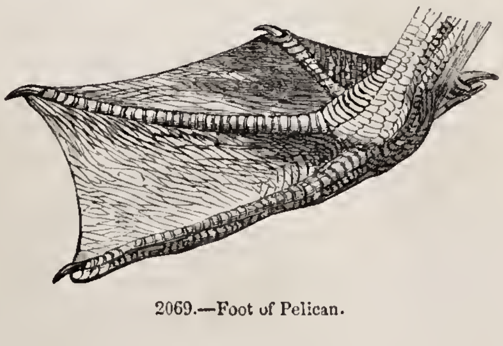
2062.—Booby, or Brown Gannet.

2064.—Pelicans.



2063.—Fowlers of St. Kilda.

2061.—Gizzard of Gannet.



2069.—Foot of Pelican.

2068.—Head of Pelican.

the sand or shingle above high-water mark, the female depositing two or three eggs in a slight cavity, upon which she seldom broods during the middle of the day, if the weather be sultry, but sits on them at night. The young birds are at first clothed in mottled down, and are carefully guarded by the parents, who are watchful and clamorous in their defence, and sweep close around the head of the intruder. The bill of this species is red, passing into black at the tip. The top of the head is black, becoming mixed with white in winter; back and wings delicate ashy grey; rump and tail white; chest pearl grey. The outer web of the outer tail-feather, and first quill-feather blackish; legs tile red. Length fourteen inches.

The common tern is migratory in its habits, passing southwards in winter. In the northern seas of our island it is rare, its place being supplied by the Arctic and Roseate Terns. The Sterna Hirundo of Wilson is a distinct species, and has been re-named by the Prince of Musignano as the Sterna Wilsonii; its habitat is the coast of North America.

2050.—THE NODDY

(*Anous stolidus*, Leach). Megalopterus stolidus, Boie; Sterna stolida, Linn.

This species is only an accidental visitor to the coasts of Europe, its principal range of habitat being confined to the Gulf of Mexico, the coasts of Florida, the Bahamas, the Tortugas, and the neighbourhood of St. Helena. Two specimens were shot off Wexford in Ireland, in 1830. It is familiar to all mariners who navigate in the equatorial regions, and is often seen in flocks hundreds of leagues from land; assiduously pursuing its finny prey, and uttering loud and discordant cries. Occasionally it alights on vessels, and suffers itself to be captured, probably being exhausted by fatigue from wandering so far away from a resting place.

Mr. Gould remarks, that the noddy, unlike the generality of Terns, builds in bushes or on low trees, making a large nest of twigs and dried grass; and while hovering round it, the old birds utter a low querulous murmur. The eggs are three in number, of a reddish yellow, blotched with dull red and purple. It does not plunge down upon its prey, like the other Terns, but as it skims along the water, during its rapid progress.

The wings when closed extend beyond the tail, which is rounded, not forked. Plumage sooty black, forehead white, passing into grey and gradually blending with the general tint. Bill and feet black.

2051.—THE SCISSORS-BILL

(*Rhynchops nigra*). Sea Skimmer, Shearwater, Cut-water; Piscator of the Chilians.

This extraordinary bird, whose beak differs from that of all its oceanic allies, is very extensively spread; it ranges along the east and west coast of America; is not uncommon on the coasts of Malabar and Coromandel, and on those of Senegal in Africa. Catesby describes it as frequent near the sea-coasts of Carolina; Lesson found it in thousands off the coasts of Concepcion (Chili); and Mr. Darwin observes that he saw it on the east and west coast of South America between latitudes thirty and forty-five degrees; and adds, that it is abundant far inland along the course of the Rio Parana, where it is said to be stationary, breeding in the marshes.

The scissars-bill is about twenty inches in length, the neck being elongated; its stretch of wing, however, is very great, giving a measurement of three feet six or eight inches; the mandibles of the bill are very compressed, and the lower, which is much the longest, bears no distant resemblance to a sharp and slender paper-cutter; its length is about five inches; the upper mandible is more than an inch shorter, more pointed, and rather stouter, having its inferior edge channelled with a groove for the reception of the lower blade, which shuts somewhat like a razor into its handle. Both mandibles are orange red at the base, but gradually become black. Figs. 2052, 2053, and 2054 show the bill of this bird in different positions.

The tail is forked.

Everlastingly traversing the surface of the water, this extraordinary bird flies with the celerity of an arrow; and with the tip of the lower mandible cleaving the liquid surface, it seizes and swallows its prey, namely, fishes, and various crustacea. In this manner flocks skim to and fro, busy in this ploughing the waves, each bird leaving its narrow wake as it dashes on in a wild irregular course, uttering loud harsh cries of exultation. Catesby says that the seissars-bill frequents the oyster banks on the coast of Carolina, for the purpose of feeding on those mollusks; Linnæus states that besides fishes and crustacea, shell-fish form part of its diet, and Lesson observes, "we had proof that this bird knew how to use its beak with advantage and the greatest address. The sandy beaches of Penco are covered with mactræ (bivalve shells) which the ebbing tide leaves nearly dry in small shallows. The scissars-bill, well aware of this, places itself near these mollusks, waiting till the valves are a little opened, when it immediately thrusts in the lower trenchant blade of its bill between them; they immediately close, and the bird then raises the shell and beats it against the beach so as to cut the contractor muscle of the mollusk, which it then easily obtains and swallows. Many times have we been witnesses of this highly perfected instinct."

The scissars-bill breeds in small flocks in marshes, on sand-banks, and low islands; the eggs are three in number, of a clear white, spotted with different shades of ash. The general colour of this species is dark umber brown, approaching black over the wings and upper surface; forehead, cheeks, throat, chest, and under parts white: a slight bar of white across the wings; feet red lead colour.

From this bird we pass to the Gulls. Attachés of the sea, from whose stores they derive their support, the Gulls on ample slowly flapping pinions are sure to attract the notice of all who visit the coast, and the mouths of our larger rivers. Easy and buoyant is their flight, as they sail along in wide circles, intent upon the waters beneath. Let the gale blow, and the billows roll, there are they making head against the wind, and performing the most graceful evolutions.

Though the gulls float on the water, they do not dive, but pouncing down skim their food from the surface, or pick it up on the muddy beach when the tide has retired. Fish, crustacea, mollusks, and dead animal matters constitute their nourishment. They breed in companies, some along the shore, others on the banks of small islets, or reefs; some in marshes, others on bold rocks. They undergo a double moult, but that of the spring is only partial. Their plumage is deep, full, and soft.

The group is spread throughout all latitudes.

2055.—THE GREAT BLACK-BACKED GULL

(*Larus marinus*). Among the various species of Gull which haunt our shores, this fine species may be often noticed flying alone or in pairs, and known by its superior size, its black mantle, and wings. It is common in the Orcades and Hebrides; and migrating south in winter, visits the coasts of Holland and France both in spring, and on the approach of the cold season. In very high latitudes it is rare; and is seldom seen in Baffin's Bay, though it is by no means unfrequent along the coast of the States of North America. Its cry is loud and hoarse. Among its breeding places in the British Islands may be named the Steep-holmes, and Sandy Islands in the Bristol Channel, Souliskerry in the Orkneys, the Bass Islands in the Frith of Forth, and the marshes at the mouth of the Thames. It builds a nest of rushes, grass, &c.; the eggs are three or four in number, of an olive green blotched with black. In its habits it is very wary, and its appetite is voracious.

We may here observe that in the genus Larus the bill is strong, straight, and cultrated; the upper mandible is curved at the tip; the lower mandible has a projecting angle, and thence slopes obliquely upwards to the point; the nostrils are placed in the middle of the beak, and are oblong and narrow. Fore-toes webbed, hind-toe small. Fig. 2056 represents the stomach of a species of Larus, laid open.

2057.—THE BLACK-HEADED, OR LAUGHING GULL

(*Xema ridibundus*). Larus ridibundus, Linn.

The species of the genus Xema (Leach) are distinguished by a more slender bill, a slighter contour, and by the head being black in summer, which colour is lost on the approach of winter, and resumed in the spring. The laughing gull is common during the winter on our coasts and those of temperate Europe; but leaves the sea on the approach of spring, and visits the lakes and fenny districts of the interior of the country, for the purpose of breeding. Here it makes a nest of decayed grass among the tufts of rushes, the female laying three or four eggs of a pale olive brown, blotched with black and grey. The young are covered with particoloured down, but soon become fledged, and towards the end of June begin with their parents their course from the interior seawards. Formerly the eggs and young were held in estimation, and, according to Mr. Selby, a gullery has produced a revenue of from fifty to eighty pounds a year to the proprietor. He notices the large pond at Pallinsburn in Northumberland, and other localities in the neighbourhood, as annually visited by flocks of these birds; and Willughby states that in his time they yearly built and bred "at Norbury in Staffordshire, on an island in the middle of a great pool," arriving about the beginning of March, and incubating towards the end of April. The young were taken and fattened for the table, to the number of one thousand two hundred annually, and sold at a high price.

The head of this species is dark blackish brown, the bill deep crimson: the general plumage pearl grey above, white beneath; wings long and pointed; legs blood red. In winter the head is white. Earthworms, slugs, aquatic insects, constitute its summer diet, and it often visits ploughed lands in quest of the larvæ of the cockchaffer; in winter it feeds upon small fish and crustacea.

2058.—THE ARCTIC SKUA GULL

(*Lestris parasiticus*). Catarrhactes parasiticus, Fleming; Larus parasiticus, Linn.

Unlike the true gulls, the Skua or Parasitic gulls are birds of rapacious habits, and are bold and destructive, resembling in many points birds of prey. Fish is their usual food; like the sea-eagle, however, they seldom obtain their livelihood by their own honest exertions, but attacking the ordinary species, they force them to give up their booty, or to disgorge it, if swallowed, and sweeping down with arrow-like velocity catch it before it reaches the water. They have the beak strong and thick, with an extended cere at the base, and hooked at the point; the claws are large and sharp, the inner one the most robust and curved; the wings are long and pointed; the tail rounded, with the two middle feathers prolonged and narrow. Their flight is astonishingly rapid, and performed in successive curves, so that it bears no resemblance to the flagging undulating and wheeling course of the gulls (Larus). Three species tenant the northern shores of our island, and the higher latitudes: namely, the common skua, a large and fierce bird, which hesitates not to assault the eagle, should the latter venture within the limits of its breeding territory; the Pomarine skua, and the Arctic skua.

The Arctic skua is widely distributed over the high northern latitudes, and is to be met with in the polar seas both of Europe and North America; it breeds upon several of the Orkney and Shetland Islands, congregating in small flocks; and the young in autumn repair to the northern coasts in England as well as those of the Scottish mainland, harassing the gulls that follow the shoals of herring, which at that season approach the shore; the adults however are rarely met with so far south, but after the breeding season migrate, as it would appear, eastward, returning to the Orkneys in May. It is common along the Baltic, and the coasts of Norway and Sweden, as well as on the lakes of the interior. The young accidentally visit Holland, Germany, France, and Switzerland. The flight of this species is very swift, and its aërial evolutions while persecuting the more peaceful fishers of the sea are extremely beautiful; but would interest the more, did we not know the injury it is inflicting on the unfortunate objects of its attack. Its nest is composed of dry grass; the eggs are two in number, of a dark olive green, blotched with liver brown. The Arctic skua defends its nest with great determination, and courageously darts at the intruder within its territory, striking at the head both with beak and wings; it also feigns lameness in the manner of the lapwing.

In perfect plumage the forehead is whitish, the top of the head blackish brown; all the under parts pure white; upper parts ashy brown, passing into blackish on the quills and tail, of which latter the two middle feathers exceed the rest by four or five inches. Bill bluish; legs black. Length fifteen inches.

Family PELECANIDÆ (PELICANS, CORMORANTS, DARTERS, &c.).

In the birds of this family, with the exception of the Tropic Birds, the cheeks, throat, and parts about the base of the bill are more or less denuded of feathers; the skin of the throat is very dilatable; the tongue is small, and the nostrils are mere slits, not easily distinguishable. The beak is long, but varies in form. All the toes are united by webs, the hind-toe having an oblique direction inwards, instead of being directed completely backwards. Notwithstanding this form of the foot, and this position of the hind-toe, with an ample web connecting it to the innermost of the anterior toes, the birds perch with facility on trees, and in the gannets we find the claw of the middle toe serrated. Wings ample; flight rapid and enduring. The air-cells of the body are amazingly extensive.

2059.—THE COMMON TROPIC BIRD

(*Phaëton ætherius*). The genus Phaëton, by some regarded as belonging to the Laridæ (Gulls), is characterized by a strong, compressed, elongated, and pointed bill with dentilated edges; the nostrils are linear; the cheeks are feathered; the legs are very small and short; the wings long and pointed; the tail short, with the exception of two long, slender, but wiry feathers.

The navigator well knows these birds as harbingers of the tropics, where, far from land, they may be seen soaring over the ocean, or giving chase to the flying-fishes, which rise in glittering shoals above the surface of the waves. Their flight is extremely graceful; they often glide along, without

any apparent motion of the wings, but sometimes dart onwards by a succession of rapid impulsive movements, cleaving the air with great velocity. On the appearance of a vessel, they generally make towards it, sail round and round it, and then shoot away, to give chase to their finny prey.

It is seldom that these birds are seen many degrees beyond the tropics, though occasionally they are driven out of the limits of their ordinary range by storms. The tropic bird rarely, if ever, settles on the water; but usually returns to its roosting-place in the evening, where it perches on trees or craggy rocks. In serene weather it is sometimes observed to settle on the backs of drowsy turtles, sunning themselves at the surface of the water. Though, as we have said, these birds usually visit their rocky resting-places in the evening, yet in latitudes remote from land they keep during the night, as well as the day, upon the wing. Lesson heard them often overhead in fine calm tropical nights, still pursuing, unwearied, their rapid course. According to Catesby, they breed on the inaccessible cliffs of the Bermudas, and in great numbers on some little islands at the end of Porto Rico. They are abundant near the islands of Bourbon and Mauritius. The natives of some of the islands within the tropics use the two long tail-feathers as ornaments of dress.

The general colour of the tropic bird is white, variegated with curved lines of black on the back; marks of black across some of the quill-feathers, and a circle of the same round the eye, ending in a point near the occiput; bill fine red; legs vermilion. Total length, excluding the long, slender tail-feathers, about eighteen inches. The Red-tailed Tropic Bird (Phaëton phœnicurus) is a distinct species, and more common in the intertropics of the Great Pacific, while the present species frequents more abundantly those of the Atlantic Ocean.

2060.—THE GANNET

(*Sula Bassana*). Fou de Bassan of the French; Solend-Gans, or Schotten-Gans of the Germans; Gans of the ancient British; Solan and Soland Goose, English.

In the genus Sula, the bill is long, thick at the base, and tapering to a sharp point; the edges are denticulated with serrations directed backwards; beneath the under mandible the skin is naked and dilatable; space round the eyes naked; tail graduated; claw of middle toe pectonated.

Gifted with unwearied powers of wing, the gannet soars over the ocean, surveying its surface with a piercing glance, and darting down with more than arrow-like rapidity on the fish which has unwarily approached the surface. This extraordinary bird is distributed over the Arctic regions of the Old and New World; in Europe, the shores of Norway and the Hebrides are their strongholds; the Bass Rock at the entrance of the Frith of Forth, the Isle of Ailsa at the mouth of the Frith of Clyde, St. Kilda, the Skelig Isles on the Irish coast, and others, are their annual breeding resorts. They are numerous in Iceland, and are found on the coast of Newfoundland, and on the north-west coast of America.

The gannet is migratory, arriving at the Bass and other places of resort about the end of March, in vast flocks, for the purpose of incubation. Thousands incubate in harmony together: the nest is composed of withered grasses and sun-dried seaweeds, and, according to Mr. Selby, the female lays only a single egg, not two, as is stated by Temminck. When first hatched, the young are quite destitute of down, and the skin is of a dark lead colour; in a few days, however, a white down makes its appearance, and soon becomes so thick and full, that the nestlings look like powder-puffs: in about two months the young are fledged.

The Bass Rock and St. Kilda may be regarded as regular gannet farms; the young are taken in great numbers, not only for the sake of the down, but also of their flesh, which, though oily and rank, is esteemed as a relish, when roasted, in many parts of Scotland; and in the Edinburgh market, and the markets of various other towns, the birds are sold at the rate of one shilling and eightpence each, to the number of many thousands. The eggs also are highly prized, and it is said that twenty-two thousand birds, and an immense quantity of eggs, are annually consumed in St. Kilda alone. The young are cured and dried for winter consumption. The precipitous Bass Rock, according to Mr. Selby, is rented from the proprietor at sixty or seventy pounds a-year; and the proceeds depend upon the produce of the gannets. "Great care is taken to protect the old birds, which the tenant is enabled to do from the privilege possessed by the proprietor of preventing any person from shooting or otherwise destroying them, within a certain limited distance of the island. From the accounts I have received from the resident there, it appears that the gannet is a very long-lived bird, as he has recognised, from particular and well-known marks, certain individuals for upwards of forty years that invariably returned to the same spot to breed; he also confirmed to me the time required for this bird to attain maturity, viz. four years, and pointed out several in the different garbs they assume during that period, stating also, that until fully matured, they have never been known to breed. During incubation, in consequence of being unmolested, they become very tame; and where the nests are easily accessible, upon the flat surface of the rock on the south-west side of the island, will allow themselves to be stroked by the hand without resistance, or any show even of impatience, except the low guttural cry of *grog, grog*. Dr. Harvey says that the surface of Bass Island is almost entirely covered in the months of May and June with the nests, eggs, and young of the gannet, so that it is scarcely possible to walk without treading on them. The flocks rise in clouds, and make such a stunning noise that it is scarcely possible to hear your companion's voice. The sea all round is covered with them, and the flocks in the distance can only be compared to vast swarms of bees. The food of the gannet consists almost exclusively of the different species of herring, on which it plunges from a great altitude, with tremendous force and rapidity; gannets have, indeed, been taken by means of a fish fastened to a board sunk to the depth of two fathoms, against which, so violent has been the shock of the bird, that its neck has been instantly dislocated, and the bill firmly fixed in the wood. Thus, plunging from aloft beneath the waves, does the bird pounce upon its finny prey, and again rise into the regions of air with surprising ease and address. Buchanan, in his 'View of the Fishery of Great Britain,' calculates that the gannets of St. Kilda alone destroy annually one hundred and five millions of herrings; yet the shoals of this fish, though man draws his millions also, seem undiminished, notwithstanding the annual havoc made amongst them. On the approach of autumn, the great body of gannets seek more southern latitudes, and in winter are met with in great abundance in the Bay of Biscay and in the Mediterranean, where the anchovy and sardine afford them an ample supply.

The general colour of the adult gannet is white; the top of the head and back of the neck being tinged with yellow, and the quill-feathers black; bill bluish grey; naked skin around the eyes dull blue; skin of throat black; webs of the toes dusky; a bluish streak along the tarsus and upper part of the toes. Length two feet eight or ten inches. The general plumage of the young of the year is dusky grey, which gradually passes into white.

Fig. 2061 represents the Gizzard of the Gannet laid open in order to show the extensive solvent glands.

2062.—THE BOOBY, OR BROWN GANNET

(*Sula fusca*). Le Fou Brun of the French.

This species, called "fou," or booby, from its apathy in allowing itself to be captured or knocked on the head, is a native of desolate islands and rocky shores in the warmer latitudes. Thousands breed at the island of Ascension, on the Bahamas, on the rocky islets of the coast of Cayenne, along the shores of New Spain and the Caracas, as well as of Brazil. It is found also in Rodriguez, the Alacrane Islands, &c.; but there are several species between which voyagers do not discriminate. Mr. Gould describes one (S. Australis) from the Tasmanian Seas:—"Like the other members of the family," he says, "this species will allow of its being taken with the hand. Some of my specimens were so taken on a rock on the Actæon Islands." Boobies often alight on vessels, and suffer themselves to be captured; and Dampier says that in the Alacrane Islands, on the coast of Yucatan, the crowds of these birds were so great that he could not pass their haunts without being incommoded by their pecking. They were ranged in pairs; and though he succeeded in making some fly away by the blows he bestowed upon them, the greater number remained in despite of his efforts to make them take wing.

Numerous voyagers have described or alluded to the persecution which the booby experiences from the frigate bird, a fact which Lesson questions, but which seems to be very generally attested. Feuillée, Leguat, Dampier, Catesby, and many more narrate their observations respecting the encounter of the frigate bird with the booby, and Nuttall says, "the boobies have a domestic enemy more steady though less sanguinary in his persecutions than man; this is the frigate pelican or man-of-war bird, who, with a keen eye descrying his humble vassal at a distance, pursues him without intermission, and obliges him, by blows with his wings and bill, to surrender his finny prey, which the pirate instantly seizes and swallows. . . . The booby utters a loud cry something in sound betwixt that of the raven and the goose, and this wailing is heard more particularly when pursued by the frigate bird, or when the assemblage happens to be seized with any sudden panic." Feuillée says, when the boobies "return in bands towards evening from their fishing, the frigate birds are in waiting, and, dashing upon them, compel them to cry as if for succour, in doing which they disgorge some of the fish which they are carrying to their young ones, and thus do the frigate birds profit by the fishing of the boobies, which they then leave to pursue their route."

In general manners the booby agrees with our gannet, except that the latter by no means merits the appellation of the former. Both walk awkwardly, and rest almost erect, supported, like the cormorant, by the stiff feathers of the tail. The brown booby is of a general dusky brown above; whitish beneath, with black primaries; the naked skin about the face is reddish; orbits yellow; legs straw colour.

In closing our account of the gannets we refer to Fig. 2063, representing St. Kilda, where, as stated, the solan-goose breeds in thousands, and where quantities of the eggs and young are taken. They are procured at the hazard of the lives of the daring fowlers, who have to clamber on the rocks at a prodigious height above a raging sea, or to be lowered by means of a rope over horrid precipices and hanging in mid air, to take their booty from the shelves and ledges which the birds occupy, regardless of the roar and din of the voices and wings of myriads of excited birds, mingling with the noise of the rushing waters.

2064, 2065, 2066, 2067.—THE WHITE PELICAN

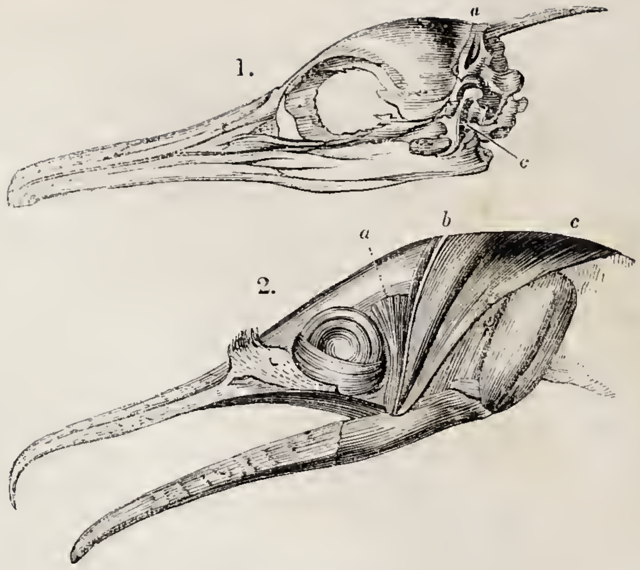
(*Pelecanus onocrotalus*). In the genus Pelecanus the bill is very long, broad, flattened, and straight, with a hooked projection at the extremity of the upper mandible: the nostrils are basal slits; the under mandible is formed of two long, slender, flexible branches uniting together at the tip, and enclosing a widely dilatable membranous pouch, which extends to the throat; tongue rudimentary; eyes surrounded by a naked space; body large; legs short; wings moderately ample; air-cells of the body extensively developed. Fig. 2068 represents the Head, Fig. 2069 the Foot, of the Pelican.

This magnificent bird is a native of Africa and India, and the southern provinces of Eastern Europe. It is common on the Danube and Volga, on the lakes of Hungary and Russia, on the Black Sea and along the coasts of Greece, and also in Egypt and the Cape of Good Hope.

Hasselquist, who saw this species at Damietta, observes that it visits Egypt in the middle of September, arriving in flocks, which form during flight an acute triangle at a great elevation. Dr. Von Siebold saw it at Japan. The pelican swims well, but, strictly speaking, does not dive. We have often seen these birds plunge their long beaks and necks under water, and net the fish in their capacious pouches: in their wild state they hover and wheel over the surface of the water, watching the shoals of fish beneath, and suddenly sweeping down bury themselves in the foaming waves, rising immediately from the water by their own buoyancy, up they soar, the pouch laden with the fish scooped up during their momentary submersion. The number of fish the pouch of this species will contain may be easily imagined when we state that it is so dilatable as to be capable of containing two gallons of water; yet the bird has the power of contracting this membranous expansion, by wrinkling it up under the lower mandible, until it is scarcely to be seen. In shallow inlets, which the pelican often frequents, it nets its prey with great adroitness in the manner already described, and which may be witnessed by observers of these birds in the Zoological Gardens.

The pelican chooses remote and solitary islands, isolated rocks in the sea, the borders of lakes and rivers, as its breeding-place. The nest, placed on the ground, is made of coarse grasses, and the eggs, which are white, are two or three in number. While the female is incubating, the male brings fish to her in his pouch, and the young, when hatched, are assiduously attended by the parents, who feed them by pressing the pouch against the breast, so as to transfer the fish from the former into the throats of the young. This action has doubtless given origin to the old fable of the pelican feeding its young with blood drawn from its own breast. Occasionally the pelican perches on trees along the margin of the water, but rocky shores are its favourite haunts. In certain localities they congregate in great numbers, mixed with other water-fowl, all harmoniously breeding together. Le Vaillant, upon visiting Dassen Eyland, at the entrance of Saldanha Bay, after wading through the surf and clambering up the rocks, beheld an astonishing spectacle:—"All of a sudden there arose from the whole surface of the island an impenetrable cloud, which formed at the distance of forty feet above our heads an immense canopy, or rather sky, composed of birds of every species and of all colours; cormorants, sea-gulls, sea-swallows, pelicans, and I believe the whole winged race of this part of Africa, assembled on this spot. All their voices mixed together, and modified according to their different kinds, formed

2065.—Pelican.



2071.—Skull and Head of Cormorant.

2073.—Crested Cormorant.

2066.—Pelicans.

2070.—Cormorant.

2067.—Pelican and Young.

2074.—Crested Cormorant.

2076.—American Darter: Male.

2077.—American Darter: Female.

2075.—Le Vaillant's Darter.

2072.—Chinese fishing with Cormorants.

2079.—Quadrupeds, Birds, &c. from Egyptian Antiquities.

2078.—Frigate or Man-of-war Bird.

such a horrid music that I was every moment obliged to cover my head to gain a little relief to my ears. The alarm which we spread was so much the more general among these innumerable legions of birds, as we principally disturbed the females, which were then sitting; they had nests, eggs, and young to defend. They were like furious harpies let loose against us, and their cries rendered us almost deaf. They often flew so near us that they flapped their wings in our faces, and, though we fired our pieces repeatedly, we were not able to frighten them; it seemed almost impossible to disperse this cloud. We could not move one step without crushing either their eggs or young, the earth was entirely strewed with them." The same enthusiastic traveller also narrates, that, on the Klein-brak river, whilst waiting for the ebb-tide, he saw assembled thousands of pelicans and flamingoes, the white of the former strongly contrasting with the scarlet of the latter.

Besides the common pelican, another species (P. crispus, Feldegg) inhabits south-eastern Europe. In America there are two species, the P. trachyrhynchus, Latham, and the P. fuscus. The former is numerous in the fur countries, where it was found breeding by Dr. Richardson, on small rocky islands, and the brink of cascades.

The white pelican, when adult, has the plumage generally of a pure white with a slight rose tinge; the feathers of the chest are long, firm, and silky, with a tinge of fine straw yellow; the quill-feathers are black, but nearly concealed beneath the wing-coverts, which are long and pointed and very regularly and beautifully disposed; the bill is yellowish, passing into red at the tip; the sides of the lower mandible and a line down the upper being lead-coloured: pouch yellow; legs livid; space round the eyes flesh-colour. Length nearly six feet; expanse of wing twelve or thirteen feet.

2070.—The Cormorant

(*Phalacrocorax Carbo*). In the present genus the bill is long, straight, compressed, with the upper mandible boldly curved at the point: the gullet is large and dilatable; sides of face and throat naked; nostrils basal and linear; tail ample and rigid.

In the Zoological Journal, vol. iv., Mr. Yarrell has described an additional bone affixed to the occiput of the cormorant, and which he calls a xiphoid bone, giving origin on each side to a long triangular muscle acting, in addition to the ordinary muscles, upon the lower jaw: he also notices the great length of the os quadratum. Fig. 2071 represents the Skull (A) and the Dissected Head (B) of the cormorant. The skull, A: *a*, the occipital ridge; *b*, the xiphoid bone; *c*, the os quadratum. Dissected head, B: *a* and *b*, muscles answering to the temporal and massiter; *c*, the triangular muscle arising from the xiphoid bone and inserted into the lower jaw.

The range of the cormorant is very extensive; it is found on the Ganges of India, over the greater part of Europe, and also in North America. It is abundant in Holland at all seasons, and is common in France and England; numbers breed on the cliffs of the Isle of Wight, and, according to Selby, on the Farn or Fern Islands; and flocks may often be seen on sand-banks near our southern coast, on isolated rocks, or sailing up and down near the shore, and up the mouths of the larger rivers. Voracious in the extreme, the cormorant is an unwearied and active fisher, pursuing its prey beneath the water, like the otter, occasionally rising to take breath, and renewing the chase. Eels are said to be a favourite food. The dilatable character of the gullet of this bird permits it to swallow fish of considerable size without difficulty, head foremost: but should the fish be seized transversely, the bird jerks it into the air, and dexterously catches it in the right position as it falls. The cormorant swims so low in the water that nothing but the head, neck, and top of the back appears above the surface, its tail, composed of stiff elastic feathers, is submerged and used as a rudder in its subaquatic evolutions, and the wings as oars; the address with which it dives, and the rapidity of its movements, are wonderful, nor less so the pertinacity with which it pursues its victims. This interesting bird sometimes builds its nest in trees, but generally on the summits of rocks: the nest consists of dried seaweeds; in the Fern Islands, according to Mr. Selby, the nests so composed are frequently two feet in height. The eggs are from three to five in number, of a bluish white. The young, when first hatched, are naked, the skin being of a purplish black; in six or seven days they become covered with black down, but the feathered plumage is not perfected till a lapse of six weeks. Yet when only half-fledged, if thrown into the water they immediately dive and pursue their submarine course to a great distance, using their imperfect wings in the same manner, and with almost as much effect, as the old birds.

In winter flocks of cormorants often wander inland, and may be seen on lakes and rivers at a considerable distance from the sea.

When the old birds are surprised on the nest, they have a strange habit of stretching out the neck, raising up the head, opening the bill, and vibrating the loose skin of the throat, while at the same time they utter a cry expressive of alarm and anger.

Ravenous as the cormorant is, it is easily tamed, and becomes very attached and familiar. One of these birds, which was caught by accident, was kept by Colonel Montagu, and soon became perfectly domesticated; it would join him at the fire-side, and dress its feathers with perfect self-possession. It lived in perfect harmony with swans, geese, ducks, and other birds, and was only excited by the sight of a fish. It never attempted to stray, and would walk in and out of the house regardless even of the dog, and was, as the colonel says, "troublesomely tame." This character Mr. Selby states that he can confirm, having himself kept these birds in a domesticated state.

As a further proof of the docile nature of this bird, we may mention that both in our country and in Holland it was trained to fish; Willughby quoting Faber says, "they are wont in England to train cormorants to fishing, when they carry them out of the room where they are kept to the fish-pools, they hoodwink them, that they be not frightened by the way; when they come to the rivers they take off the hoods, and having tied a leather thong round the lower part of their necks, that they may not swallow down the fish they catch, throw them into the river. They presently dive under water, and there for a long time with wonderful swiftness pursue the fish, and when they have caught them they arise presently to the top of the water, and pressing the fish lightly with their bills they swallow them, till each bird hath after this manner devoured five or six fishes. Then their keepers call them to the fist, to which they readily fly, and little by little disgorge all their fish, a little bruised with the nip they gave them with their bills. When they have done fishing, setting the birds on some high place, they loose the string from their necks, leaving the passage to the stomach free and open, and for their reward they throw them part of the prey they have caught, to each, perchance, one or two fishes, which they, by the way, as they are falling in the air, will catch most dexterously in their mouths." Swammerdam states the circumstance of trained cormorants being brought from Holland to England for sale. Latham observes that "Whitelock says he had a cast of them manned like hawks, and which would come to hand; and relates, that the best he had were presented to him by Mr. Wood, master of the cormorants to King Charles the First." In China at the present day an allied species, the Ph. sinensis, is bred and trained to fishing, it would appear, even without a ligature round the neck; as is narrated by Sir George Staunton, who observed them on the southern branch of the canal in his journey to Han-choo-foo: he says, "On a large lake close to this part of the canal, and to the eastward of it, are thousands of small boats and rafts, built entirely for this species of fishery. On each boat or raft are ten or a dozen birds, which at a signal from the owner plunge into the water; and it is astonishing to see the enormous size of the fish with which they return grasped between their bills." Le Compte, an old French writer, states that the Chinese do put a string round the birds' necks, contrary to what Sir G. Staunton affirms; and it is not improbable that both may be correct. Fig. 2072 well illustrates the Chinese mode of employing the birds in question.

The adult cormorant is a handsome bird. Top of the head, neck, breast, lower part of the back, and under surface of a glossy greenish black; a white band stretches across the throat, and white silky hair-like feathers are scattered over the upper part of the neck; top of the back and wings fine bronze brown, each feather having a marginal belt of rich velvet black; quill and tail feathers black; bill dusky; skin of the throat yellow; iris bright green; a white patch upon the thighs; legs dusky black. A semi-erect crest on the back of the head. Length about three feet; extent of wings nearly four feet.

2073, 2074.—The Crested Cormorant

(*Phalacrocorax cristatus*). Cormoran Largup of Temminck; Shag or Green Cormorant of Gould, Selby, and others.

The crested cormorant, or shag, is widely spread over the north of Europe, but is not an American species. It is common on various parts of our coast, breeding in the clifts and on the ledges of perpendicular cliffs (not like the preceding, on the top), and making a nest of seaweeds. Its habits, manners, and food are precisely the same as those of the cormorant, and require no separate detailed account.

The crest of this species, which consists of an occipital tuft of long green feathers, is lost after the breeding season. (Fig. 2074.) The upper part of the back and shoulders of a deep bronzed green, each feather being margined with velvet black; head, neck, and under surface lustrous silky blackish green; tail of twelve black feathers; bill and legs black; guttural skin, and corners of the mouth gamboge yellow, the former with black specks; iris green. Length two feet one or two inches.

The foreign species of the genus Phalacrocorax are very numerous, and generally distributed throughout the different quarters of the globe;—Europe, Asia, Africa, America, and Australia having their respective examples.

2075.—Le Vaillant's Darter, or Snake-bird

(*Plotus Levaillantii*). The darters, or anhingas, as Buffon and the French naturalists term them, are most extraordinary birds, remarkable for the length and slenderness of the neck, which bears no distant resemblance to the slim form of a snake, attached to the body of a cormorant; the beak is long, straight, pointed, and obliquely dentilated along the edges: the face and throat are naked, the wings rather short; the tail ample and composed of rigid feathers. The darters perch upon trees along the margin of rivers, lakes, and creeks; they swim with the body completely submerged, the long neck alone rising out of the water. When thus seen, they might be mistaken at a casual glance for snakes, and Le Vaillant says that when the birds are perching the neck is in a state of constant oscillation, and that any one who saw its tortuous movements amidst the foliage of the trees, the body being concealed, would take it for one of the tree-serpents.

During flight the neck is stretched out in a line with the body. The species are limited; one is found in the Old World,—one in the New.

Le Vaillant's darter is a native of Senegal, the Cape of Good Hope, some parts of India, and of the islands of Java and Sumatra. It feeds on fish, which it pursues, like the cormorant, under water, using its tail as a rudder in its subaquatic evolutions.

Small fish are swallowed whole, but larger prey is carried to the trunk of a tree or rock, where the bird, fixing it securely beneath its feet, picks it to pieces. Though the water is the favourite element of the darter, according to Le Vaillant, it is upon trees and rocks that it establishes its nest and rears its young; always choosing situations favourable to the escape of the brood, when fledged, or when alarmed, into the water. This species is extremely shy and wary, and difficult of approach; so instantaneous are its actions in the water, that it dives before the shot reaches it, upon the drawing of the trigger, and often doubles back, emerging far behind the sportsman, and, taking wing, sails away to a distance. In full plumage all the upper part of the head and back of the neck are brick red, bordered with a riband of black which descends to the shoulders; forehead, cheeks, and sides of neck white; throat and anterior part of neck, ochre yellow; chest and under parts black, with green reflexions; base of the neck, reddish, with spots of white; upper surface brown, the middle of each feather of a bright rust colour; quills and tail brown; beak and feet yellow.

2076, 2077.—The American Darter

(*Plotus Anhinga*). The American Darter, or Snake-bird, is a native of the Carolinas, Georgia, the Floridas, and Louisiana; it is common in Brazil and Cayenne. Like the African species it swims with the body submerged, and its long neck vibrating in a peculiar manner. "The first individual," says Mr. Ord, "that I saw in Florida was sneaking away to avoid me along the shore of a reedy marsh, which was lined with alligators; and the first impression on my mind was that I beheld a snake, but the recollection of the habits of the bird soon undeceived me. To pursue these birds at such times is useless, as they cannot be induced to rise, or even expose their bodies." "Wherever," adds the same naturalist, "the limbs of a tree project over and dip into the waters, there the darters are sure to be found, these situations being convenient resting-places for the purpose of sunning and preening themselves, and probably giving them a better opportunity of observing their finny prey. They crawl from the water upon the limbs, and fix themselves in an upright position, which they maintain in the utmost silence. If there be foliage or long moss they secrete themselves in it in such a manner that they cannot be perceived unless one be close to them. When approached they drop into the water with such surprising skill that one is astonished how so large a body can plunge with so little noise, the agitation of the water being apparently not greater than that occasioned by the gliding of an eel."

Bartram, who states that he has seen paintings of the darter on Chinese screens, and other Indian pictures, was not, we suppose, aware of the distinction between the American and Old World species

which, till Temminck extricated them from a labyrinth of error, were confounded together under the title of Plotus melanogaster. According to Bartram these birds "delight to sit in little peaceable communities on the dry limbs of trees, hanging over the still waters, with their wings and tails expanded, to cool and air themselves, when at the same time they behold their images in the watery mirror. At such times, when approached, they drop off the limbs into the water as if dead, and for a minute or two are not to be seen, when on a sudden, at a great distance, their long slender head and neck appear, like a snake rising erect out of the water. In the heat of the day they are seen in great numbers sailing very high in the air over lakes and rivers." These birds build in the trees of swamps and islands in the midst of lakes or sheets of water, and occupy the same station for a series of years: the nest is large, and made of sticks, and the eggs are blue.

The plumage undergoes several changes before the perfect livery is attained. In full plumage the general colour is glossy greenish black; the scapular feathers are long and slender, ornamented with a streak of white down the centre of each, and forming a sort of plume over the back and wings; side of the neck from the eye backwards marked throughout half its length with a stripe of brownish white, consisting of long hair-like feathers; a few tufts on the crown; wings black, beautifully variegated with silvery white; bill black above, yellow below; naked skin of face and throat yellow; legs yellow; middle claw pectinated; plumage stiff and elastic. In the female and young the front of the neck is of a rusty grey colour, which extends over the breast. Length about two feet eight or ten inches, but the body does not much exceed in size that of a large duck. Fig. 2076 represents the Male, Fig. 2077 the Female.

2078.—The Frigate or Man-of-war Bird

(*Tachypetes Aquilus*). The genus Tachypetes is characterized by a strong elongated beak, depressed in the centre, and abruptly hooked at the end; the nostrils are mere slits in a suture running along each side of the upper mandible; the tarsi are extremely short; the webs of the toes deeply notched; the wings extremely long and narrow; the tail is forked; an extensive naked gular pouch: one species only is ascertained.

Noted for its raptorial habits, the frigate bird soars on rapid pinions over the broad expanse of ocean, principally in intertropical latitudes, and tyrannizes over the gulls and boobies, from whom it forces the prey they have captured. At immeasurable distances from shore it pursues its habits of rapine, but is never known to repose on the water; rapid as an arrow it plunges from its altitude upon the shoals of flying-fish, which rise glittering above the surface, or upon some unfortunate sea-bird which has made a capture, and which it harasses till it obtains the booty. No bird is more at home in air, or sweeps along on more rapid pinions. Supported, says Mr. Vigors, "in its unlimited flights by the strength and expansion of its wings, and aided by the singular mechanism of its tail, and the buoyant nature of the inflated sac which distends its throat, it seems to be an inhabitant of the air rather than of the land, to which it resorts alone for the duties of its nest, or of the water, over which it only hovers for its prey." It may here be added that the long wing-bones are hollow, thin, and light, and that the air-cells of the whole body are extremely developed, while, in proportion to the expanse of wings, the total weight of the bird is very trifling; hence can it repose in the upper regions of the air, suspended without effort.

Sloane, who saw these and tropic birds when he came into latitude 13° 10′, says, "The man-of-war bird seems very large, bigger than a kite, and black; they fly, like kites, very high, and often appear immovable over the water, to wait for and catch small fish appearing on the surface: they are sharp winged, and their tail is forked. When flying-fishes are persecuted under water by dolphins, bonitos, &c., they rise and fly for some space in the air, and are often devoured by these birds in that time. We saw them first when we came near Barbadoes. The sailors guess themselves not many days, or about two hundred leagues, off the islands when they spy them first; and it is wondered how they can direct their course to the land at nights, being so far distant; but it seems no very strange matter, because they are very high in the air, and can see land much farther than those on the deck or topmast of a ship. The reason of their flying so high may be to have a greater field before them for prey, because they may go where they see the dolphins follow or hunt the flying-fishes. They are commonly thought in the West Indies to foretel the coming in of ships, for when they see a man-of-war bird come into their ports, they reckon ships will soon follow, and it is very often true, for they love to fish in not very rough weather, so that when it blows hard at sea, they come into the ports and bays to fish, where the wind is broken off by the land, and the same wind blowing them in brings in the shipping after them. There are more of these in the firm land of America than in the isles. One of these birds at Panama coming to take sardinas that were a-curing in the sun, a negro broke his wing with a stick he had in his hand: the body, after it was clear of its feathers, was little bigger than a pigeon. The wings being extended, no man, though several tried, could reach, with his arms stretched out, within four inches of the tips of them." The fat was considered by the Indians and others a sovereign remedy in some diseases, such as sciatica, &c.

These birds are said to build their nest on precipitous rocks near the sea. The eggs are stated to be of a carnation tinge dotted with crimson, and one or two in number. The length of the male, including the tail, is three feet; expanse of wing eight feet; gular air-pouch red; general plumage blackish umber brown. In the female the pouch is less and the plumage of a duller hue.

2079.—Quadrupeds, Birds, &c., in Outline, from Egyptian Antiquities.

At the conclusion of our sketch of the Birds contained in our Pictorial Museum, we take the opportunity of referring to these sculptured forms, which are interesting to the naturalist as enabling him to compare the present animal productions of Egypt with those of ages past, and which prove that the revolutions of time, the changes of empires, and the alterations of the land, have but slightly affected the productions of the land of the Pharaohs.

Among the quadrupeds we recognise a large baboon, the Egyptian hare, the lion, the sheep, the dog (greyhound), the lioness, the bull, and apparently a mouflon. Of birds we have a species of lapwing, goose, vulture, ibis, hawk, owl, swallow, the demoiselle or Numidian crane, the stork flying, the duck, and the Percnopterus, or Pharaoh chicken. Page 72 contains a few additions to the birds of our Museum, some of which will require our particular notice.

2080.—The Whip-poor-Will

(*Caprimulgus vociferus*, Linn.). Antrostomus vociferus, Gould.

This species of night-jar, so well known in North America for the peculiarity of its cry, is described in vol. i. p. 287.

2081.—Chuck-Will's-Widow

(*Caprimulgus Carolinensis*). Antrostomus Carolinensis, Gould.

This night-jar is also described in vol. i. p. 287.

2082.—The Song-Thrush and Fieldfare

(*Turdus musicus* and *T. pilaris*). For the description of these well-known birds refer to vol. i. pp. 322, 323. In our illustration, *a* represents the Song-Thrush; *b*, the Fieldfare.

2083.—The Glossy-headed Shortfoot

(*Micropus chacocephalus*, Swainson). Ixos chalcocephalus, Temm.

This species forms one of the family of the Merulidæ (vol. i. p. 322), and is a native of Java, inhabiting the woody district of Bantam, but of its habits we have no details. In the male the whole of the head is metallic black with violet reflexions; the upper parts of the body are of a leaden grey; quills black; tail grey, with a band of black and a white termination; breast deep grey becoming brighter on the under parts. The female is more obscurely coloured. Length six inches and a half.

2084.—Bunting

(*Emberiza*), Head of. In this head the peculiar character of the beak of the genus is well displayed, and the tubercle on the palate of the upper mandible is very conspicuous. (See Common Bunting, vol. i. p. 331.)

2085.—The Yellow-Hammer or Yellow Bunting

(*Emberiza citrinella*). Male. This elegantly coloured but well known British bird, so conspicuous in our hedgerows and copses, is described in vol. i. p. 331.

2086.—The Warty-faced Honey-eater

(*Zanthomyza Phrygia*, Gould). This beautiful bird, termed the Mock Regent Bird by the colonists of New South Wales, is one of the most lively-coloured of the Honey-Eaters. (See Meliphagidæ, vol. i. p. 379.) Its plumage is rich yellow and deep black most agreeably varied. According to Mr. Gould, "it is a stationary species, and enjoys a range extending from South Australia to New South Wales." "Although it is very generally distributed, its presence appears to be dependent on the state of the eucalypti, upon whose blossoms it mainly depends for subsistence; it is consequently only to be found in any particular locality during the season that those trees are in full bloom. It generally resorts to the loftiest and most fully flowered tree, where it reigns supreme, buffeting and driving every other bird away from its immediate neighbourhood; it is, in fact, the most pugnacious bird I ever saw, evincing particular hostility to the smaller Meliphagidæ, and even to others of its own species that may venture to approach the trees upon which two or three have taken their station." "I met with it in great abundance among the bushes of New South Wales, and also found it breeding in the low apple-tree flats of the upper Hunter. I have occasionally seen flocks of from fifty to one hundred in number, passing from tree to tree, as if engaged in a partial migration from one part of the country to another, probably in search of a more abundant supply of food. Its note is a peculiar loud whistle, not entirely devoid of melody. The nest, which is usually constructed on the overhanging branch of a eucalyptus, is round, cup-shaped, about five inches in diameter, composed of fine grasses, lined with a little wool and hair. The eggs are two in number, of a deep yellowish buff, marked all over with indistinct spots and irregular blotches of chestnut red, and dull purplish grey, particularly at the larger end, where they frequently form a zone." (Gould, 'Birds of Australia.')

In size this species equals the common thrush.

2087 (*a*).—The Kori Bustard

(*Otis Kori*). This noble species of bustard, from the interior of South Africa, is described in the present volume, at page 15.

2087 (*b*).—The Houbara

(*Otis Houbara*). This elegant bustard is a native of Barbary, Arabia, Persia, and occasionally occurs in south-eastern Europe. It is taken in Persia by means of trained hawks, as noticed in vol. i. p. 27.

The wide desert plains are the abode of this species, which in habits and manners resembles the rest of its family.

The sides of the neck and chest in the adult male are graced by a range of long plumes, the foremost and upper portion of which is white; the remainder black. The front of the neck is white minutely mottled with grey. The head is surmounted by a beautiful crest of white plumes. The upper surface is tawny yellow, with zigzag bars of black; under parts white. The young male wants both the crest and ruffles down each side of the neck; and it is probable that after the breeding season the adult male loses these ornamental appendages.

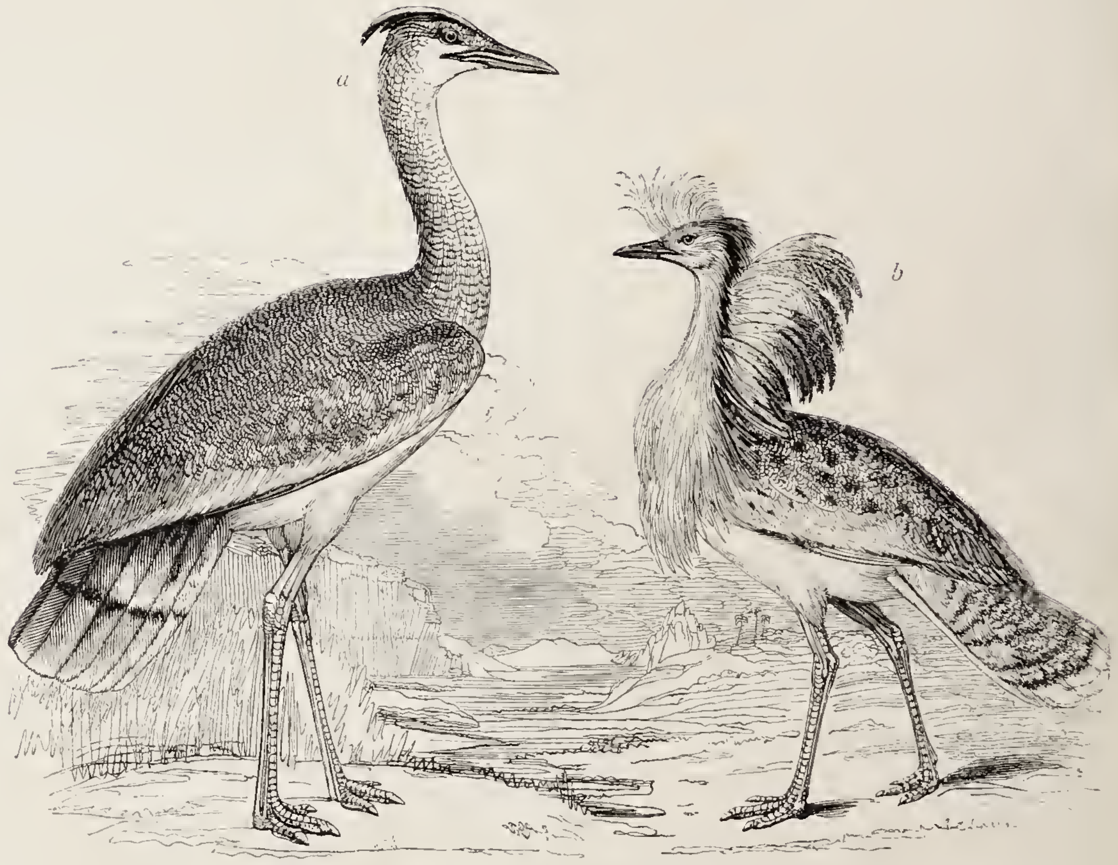
END OF THE CLASS AVES, OR BIRDS.

2081.—Chuck-Will's-Widow.

2084.—Head of Bunting.

2085.—Yellow Bunting.

2086.—Warty-faced Honey-eaters and Nest.



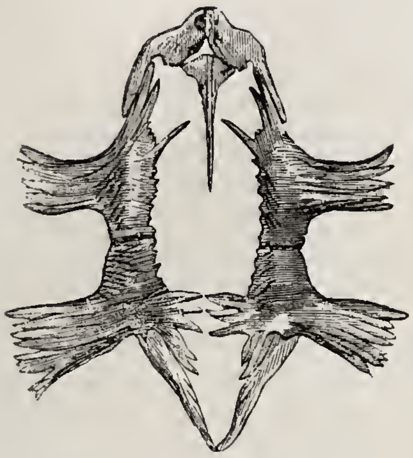
2087.—Kori Bustard, and Houbara.

2082.—Fieldfare and Song-Thrush.

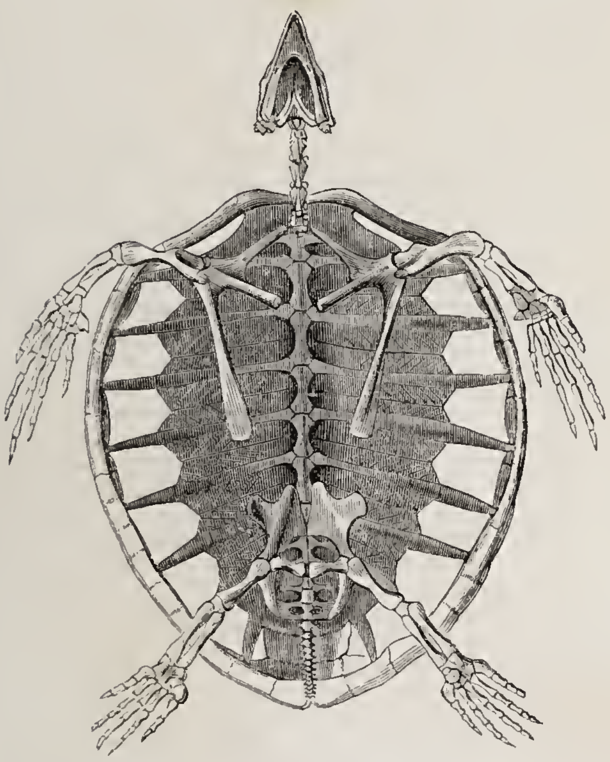
2080.—Whip-poor-Will.

2083.—Glossy-headed Shortfoot.

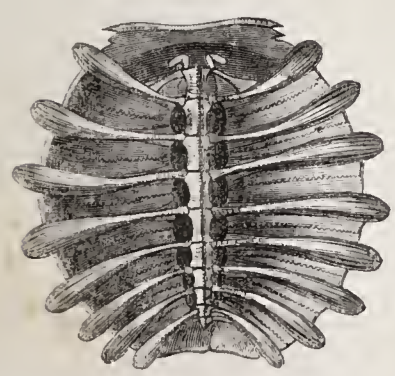
2093.—Sternum of River Tortoise.



2094.—Sternum of Loggerhead Turtle.

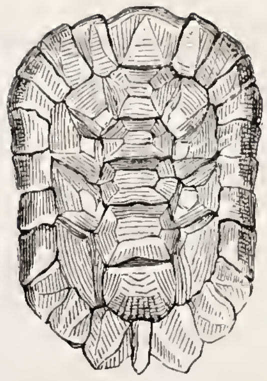


2089.—Skeleton of Loggerhead Turtle.

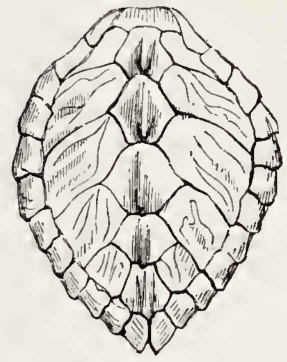


2090.—Carapace of River Tortoise.

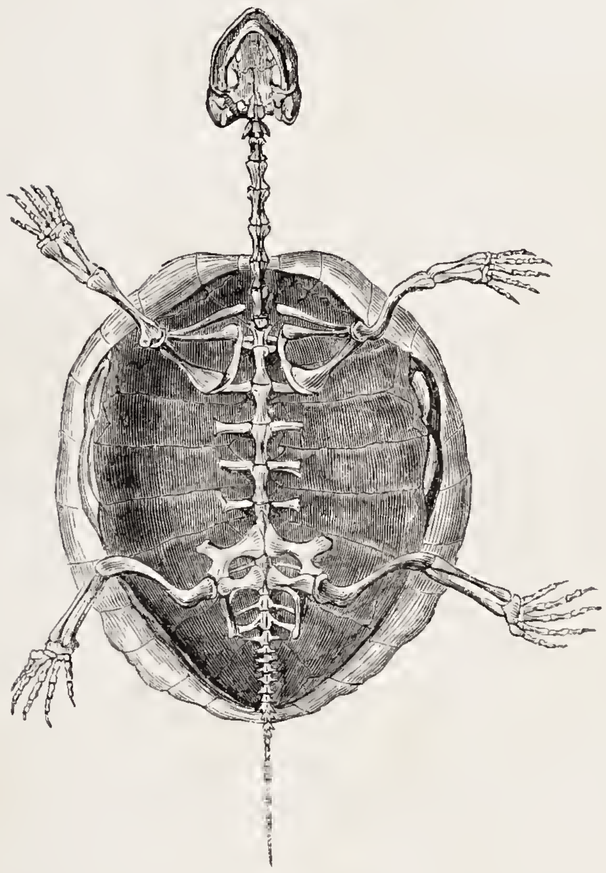
2096.—Chlamyphorus.



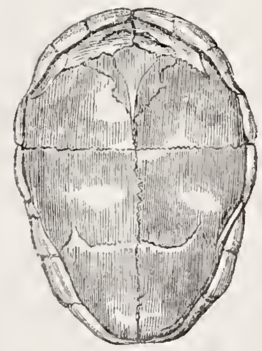
2091.—Carapace of Bordered Tortoise.



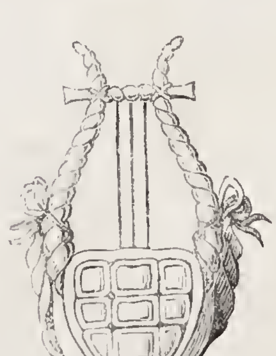
2092.—Carapace of Loggerhead Turtle.



2088.—Skeleton of Marsh Tortoise.



2095.—Sternum of Marsh Tortoise.



2097.—Grecian Lyre.—From Mersenne.

CLASS REPTILIA (REPTILES).

We now advance to another department of our Pictorial Museum, and enter upon our collection of Reptiles—a singular class of beings, presenting the most wonderful variety of form and structure, and consequently adapted for different habits of life, different localities, and different modes of locomotion. We may take by way of examples the Tortoise, the Lizard, the Snake, and the Frog: the contrast is startling, and we are ready to say—Can these forms be comprehended together under one natural great group or class, or are they not examples of distinct classes? We may observe, that many naturalists, and among them Mr. Bell, Mr. Gray, and others, regard the Frogs, Newts, Protei, &c. as a distinct class, under the title Amphibia; while, on the other hand, Brongniart, Cuvier, Oppel, and others place the Amphibia as an order or section within the pale of the Reptilia. Moreover, between the long, twining snakes, and the solid, heavy, shield-covered tortoises, the distance is very great; much greater than between any forms of the two previous classes, viz. Mammalia and Birds; much greater than between the elephant and mouse, the eagle and humming-bird; almost, indeed, as much as between the bird and quadruped, excepting that the oviparous mode of reproduction obtains both in the tortoise and snake, which, be it observed, is also the case with birds—a point in which they exhibit a certain degree of approximation to the Reptilia.

Without entering into an analysis of the various modes of arrangement which different naturalists have instituted, all of which have their objections, let us proceed to a general review of the common characteristics of these animals, dividing them into Tortoises (Chelonia), Lizards (Sauria), Serpents (Ophidia), and Frogs (Amphibia). All are vertebrate, with cold, red blood, of a variable temperature; breathing by means of lungs, sometimes by branchial tufts or gills: the skin is covered neither with hair nor feathers, but with solid shields, horny plates, scales, spines, or granules; otherwise, as in the Amphibia, it is naked. The heart consists essentially of two auricles and a ventricle. There is either no external organ of hearing, or merely an orifice, open in some, in others covered with a tympanic membrane, in a few protected by a moveable valve. The limbs are variable; four, two, or none. The appetite is in general carnivorous; sometimes, however, frugivorous. Of some the bite is deadly. A high temperature is most congenial to their nature, and it is in the hotter regions of the globe that they abound in the greatest numbers, both specifically and individually, and display the most varied forms, the most gigantic bulk, and the most dazzling colours. As our preliminary observations must be very brief, we shall at once pass to our first order (perhaps subclass), hoping that as we advance we shall gradually develop the characters of each in rotation.

ORDER CHELONIA (TORTOISES)

(χελώνη, a tortoise). These strange animals, as is well known, are covered with natural armour, which may be considered essentially a portion of the osseous framework, thrown, as it were, outside of the body so as to constitute an external bony envelope or box, enclosing and protecting the internal muscles and viscera, and covered on the outer surface by plates of horny matter, scales, or a leathery expansion.

The box thus formed is composed of two portions: an upper portion, called the buckler, back-plate, or carapace (clypeus), composed of the vertebræ of the back and loins, and also of the ribs, all expanded and consolidated together; a lower portion, called the plastron, or breastplate (sternum), consisting of nine osseous portions, eight in pairs, the ninth single, and occupying the anterior part of the plastron. The distinct bones forming the plastron vary much, in different groups, in their consolidation and degree of development; it is in the land tortoises that the solidity of this portion is at its maximum. The same remark holds good with respect to the carapace, which presents different degrees of form, expansion, convexity, and of external covering in the several subordinate groups and genera.

The upper and under shields are in general united at the sides, leaving before and behind a space for the protrusion of the head, limbs, and tail; and these in general can be more or less completely retracted under cover, and sometimes completely shut up, either by the carapace or plastron being transversely hinged. The union of the carapace and plastron at the sides, is by means of what are termed costo-sternal bones, analogous perhaps to the sternal ribs of the Sauria.

Where the carapace is covered with plates or scales, they are divided into vertebral, costal, and marginal: the vertebral plates running longitudinally down the centre, and five in number: the costal plates are usually four, sometimes five, on each side; these are surrounded by the marginal plates, consisting of a nuchal plate, of a caudal plate, sometimes single, sometimes double, and of a variable intermediate number. The plates of the plastron and of the bones of union are variable. In the marsh-tortoise those of the former are six on each side, those of the latter two. In the loggerhead-turtle they are more numerous and differently arranged. We shall give a better idea of the structure of the carapace and plastron of these animals, and of their connection with the skeleton, by referring to our figures, than by any explanation. Fig. 2088 represents the Skeleton and Carapace of the Common Marsh Tortoise (Cistudo Europæa), seen from below.

Fig. 2089 represents the Skeleton and imperfect Carapace of the Loggerhead Turtle (Chelone Caouana), seen from below.

Fig. 2090, the Carapace of the River Tortoise (Trionyx, Geoffr.; Gymnopus, Bibron), as seen from below. In this group the osseous part of the carapace is very much reduced, and flat, with an extensive cartilaginous circumference, the upper surface being covered with a coriaceous membrane.

Fig. 2091 is the Carapace of the common Bordered Tortoise (Testudo marginata), covered with its horny shell.

Fig. 2092 is the Carapace of the Loggerhead Turtle (upper surface), covered with its horny plates disposed in imbrications.

Fig. 2093 represents the imperfectly developed Sternum of the River Tortoise (Trionyx).

Fig. 2094 is the still more imperfect Sternum of the Loggerhead Turtle.

Fig. 2095 is the complete Sternum of the Marsh Tortoise (Cistudo Europæa). The contrast between this and the two preceding is remarkable, yet in each the essential components are the same.

It may appear at first sight that there is a great affinity between the armour, or rather box, in which the tortoise is enclosed, and the coat of mail with which many quadrupeds are covered, as for instance the Armadilloes and the Chlamyphorus (See Chlamyphorus, Fig. 2096). There is this important difference;—the coat of mail in these quadrupeds (Mammalia) is a simple horny addition to the skin itself, resting upon and supported indeed by bold processes of the skeleton; whereas the osseous carapace and plastron of the tortoise, however developed, are part and parcel of the skeleton itself, which, as we have said, is so modified as to protect the internal organs, enclosing them as in a casket, which is itself covered either with horny plates variously arranged, or with a tough leathery skin, often thickened and carried out beyond the circumference of the osseous portions. Of the carapace of the tortoise Mercury is fabled to have formed the ancient Grecian lyre, of which one with only three strings, as given by Mersenne, is represented at Fig. 2097.

The lungs of the tortoise are very extensive, and lie under the vaulted carapace, but it must be evident that they cannot, from the immobility of the carapace and sternum, be filled with air by any action resembling that of quadrupeds or birds in breathing, and in which the chest is alternately expanded and contracted. The tortoise swallows or gulps down air; the jaws being firmly closed, the cavity of the mouth is enlarged by the drawing down of the root of the tongue, and into the vacuum thus formed the air rushes in through the nostrils. The free part of the tongue is now applied to the posterior orifices of the nostrils so as to stop them, the gullet is also closed, the root of the tongue is elevated, the broad muscles of the throat contract, and the air is forced down the windpipe into the lungs, which become filled by a repetition of the process. The air is returned by the simple pressure of muscles within the plastron and carapace. It is in this manner that reptiles without ribs, as the frog and toad, perform the act of breathing.

The jaws of tortoises are not armed with teeth, but cased in sharp-edged or serrated horny coverings, enabling them to crop and mince the vegetable aliment on which they feed. In some species of carnivorous appetite, as the Trionyx, there are thick fleshy lips around this beak, and in one species, the Matamata, the horny sheath is so rudimentary, that many naturalists have overlooked it.

The tongue of the tortoise is thick, fleshy, and very movable, though not capable of protrusion; it is abundantly supplied with nerves, and covered with nervous papillæ. It is provided with salivary glands, and doubtless enjoys to a high degree the sense of taste.

With respect to smell, from the simplicity of the olfactory organs, it appears to be but imperfect, though sufficient for the necessities of the animal.

Though the organs of hearing are not apparent externally, they exist internally, and in a tolerably perfect condition, yet tortoises appear by no means to have the sense of hearing acute; indeed the gigantic tortoises on the Galapagos Islands are believed by the inhabitants to be perfectly deaf, and Mr. Darwin states that they certainly do not overhear a person walking close behind them.

Tortoises have the eye well developed and large; as in birds, it has an osseous ring, or circle of osseous plates, around the ball, and is defended by a membrana nictitans and two external eyelids; there are also lachrymal glands. The pupil is circular.

In the terrestrial tortoises the skull is broad across the occiput, obtuse anteriorly, strong, and solid; the orbits are nearly circular, and the depression for the reception of the vast temporal muscle is both deep and extensive; the occipital ridge is elevated; the cavity for the brain is contracted; the articulating condyle is a prominent tubercle; the horny covering of the upper jaw is strongly serrated, there being an inner as well as an outer ridge, and the inner ridge is received into a serrated channel of the horny ridge of the lower jaw, the outer ridge, which is deep, passing anteriorly, when the jaw is shut. This structure, reminding us of an array of real teeth, renders the crushing and chopping up of vegetable aliment easily effected. Figs. 2098, 2099, 2100, and 2101 represent the Skull of the Indian Tortoise, in profile, as seen from above, as seen from below, and as seen from behind.

In the marine tortoises, or turtles, the cerebral cavity may be said to have a double roof; for by a production of the bones of the upper part of the head, a double vault is produced, within which, and above the true surface of the cranium, are lodged the temporal muscles of enormous volume, and to which this vaulted roof forms an osseous envelope. This structure gives to the skull an appearance of being larger than it is in reality, for the cerebral cavity is very small. In the Matamata (Chelys fimbriata) the same peculiarity prevails; the skull of this tortoise, a fierce aquatic species, inhabiting the lakes, morasses, and rivers of South America, is very remarkable. It is extraordinarily large and flat, appearing as if it had been crushed; the small orbits are seated close to the end of the muzzle; the posterior region of the cranium is elevated, in consequence of the vaulted arrangement of the bones described. The cerebral cavity is very trifling. Figs. 2102, 2103, 2104, and 2105 show the Skull of the Matamata in different positions, viz. as seen from above, as seen from below, in profile, and in a back view. In the back view the vaulted structure is very distinguishable, but the covering is here narrow, leaving anteriorly two extensive, but not deep, uncovered fossæ, as seen at Fig. 2102, over the back of which the bone stretches like a bridge. The articulating single condyle is very prominent, and just above it (Fig. 2105) is the cerebral cavity.

The limbs of tortoises differ remarkably, from an elephantine club-foot, with the strong claws only apparent, to feet divided and webbed, and so on to limbs formed into large undivided paddles, by means of which the species wing their way in the rolling ocean, as birds through the regions of air.

The motions of ordinary tortoises on land are proverbially slow: they hobble along, with an awkward irregular gait, on their ill-shaped club-feet, and seem with all their toil to make but little way; they do not put the sole fairly to the ground, but rest upon the edge, which is furnished with horny laminæ, tubercles, or hoof-like nails. Ill-provided as they may appear to be for the work of burrowing, yet they excavate pits with unexpected facility, and by dint of labour contrive to bury themselves in the soft ground, scraping up the earth with the fore-feet, and throwing it behind with the posterior pair. Hybernation appears to be general among the terrestrial species.

Tortoises eat slowly and deliberately, and we have seen them, when at work on their vegetable food, place their fore-limbs upon it, so as to press it to the ground, when, having seized a portion between the jaws, they separate it by drawing the head rapidly backwards.

These animals, as is well known, endure long fasting with impunity, and are extremely tenacious of life, surviving for days, or even weeks, the severest wounds and mutilations. We shall not enter into

any details of experiments. With this tenacity of life is connected a low degree of sensation, but a high degree of irritability, the characteristics of a low grade of existence. In a natural state they live through a long succession of years. In the Bishop's garden at Peterborough, a tortoise died in 1821, which must have exceeded two hundred and twenty years. The Lambeth tortoise, which was introduced into the garden by Archbishop Laud, about the year 1625, and which died in 1753, in consequence of some neglect on the part of the gardener, lived in its last situation one hundred and twenty-eight years. Gilbert White notices one in a village in his neighbourhood, said by tradition to be one hundred years old, and records some interesting details of one which had been thirty years a captive. In the 'Proceedings of the Zoological Society' for July, 1833, will be found the notice of one of the gigantic tortoises in the gardens, and which had been recently presented by Lieutenant Sir Charles Colville, late governor of the Mauritius. It was "one of those which were brought from the Seychelles Islands to the Mauritius or Isle of France, in 1766, by the Chevalier Marion du Fresne, and is believed to have since remained unchanged in size and appearance; consequently in 1833 it had been sixty-seven years in the island, having been full-grown, or at least as large as it was in 1833, and hence what its real age might be it was impossible to conjecture. Its length, measured along the curve of the back, was four feet four inches; its breadth, taken in the same manner, four feet nine inches; the length of the plastron two feet eight inches; the breadth of the same two feet one inch and a half; its weight two hundred and eighty-five pounds.

The Chelonia, or tortoises, are divided by MM. Duméril and Bibron into—I. Terrestrial or Land Tortoises. II. Marsh Tortoises, or Emydes. III. Fluviatile or River Tortoises. IV. Marine Tortoises, or Turtles. Terrestrial tortoises have the body short and oval, with the carapace greatly arched, within which they can withdraw the head, limbs, and tail for protection. In the genus Pyxis the anterior part of the plastron is movable on a transverse hinge, and shuts up the head and fore-limbs: in the genus Cinixys the posterior part of the carapace moves on a hinge. Slow, quiet, and inoffensive, these animals seldom wander far from their habitual haunts, and trust only to their passive means of defence when molested, yet so strong is their natural intrenchment, and so enduringly can they remain cooped up within, that, man excepted, there are few ordinary animals which they have much cause to fear; the eagle, hawk, or crow may indeed manage in one way or another to kill small species; they may soar up with their victim and let it fall from a vast elevation, or the crow may pick away at the head, withdrawn within the shell, and bit by bit tear out its prey, but a large species of two hundredweight may bid defiance to any land animal. It is rarely, if ever, that terrestrial tortoises enter the water; they are often, however, found to live along its margin, or in the neighbourhood of streams and lakes, influenced doubtless by the abundance of vegetation, and the soft quality of the soil, since they not only dig a shallow pit in which to hybernate (at least in extra-tropical counties), but bury their eggs, lightly covering them with earth, and leaving them to be brought to maturity by the warmth of the sun. The eggs of terrestrial tortoises are generally round; some, however, are elongated, but are never of the oval shape of those of a fowl. They are covered with a calcareous shell of considerable firmness.

The plates of horn with which the bony carapace is covered, are often beautifully stained and marbled, or spotted, and adorned with alternate concentric lines and furrows, disposed in regular figures. The young, however, after exclusion from the egg, differ materially in form and colouring from the adults, and the carapace is smooth. In these animals the female is generally more thickly built than the male, and has the plastron flat, while in the male it is more or less concave.

2106.—THE FURROWED TORTOISE

(*Testudo sulcata*). In the genus Testudo the nails on the anterior feet are five; carapace and plastron immovable.

The Furrowed Tortoise attains to a large size, and is a native of Africa, but if the specimen brought by M. d'Orbigny from Patagonia prove to be identical, it must also be enumerated among the productions of South America: the specimen in question was young. The circumstance of Africa and South America being alike tenanted by this tortoise, as M. Bibron observes, is most extraordinary, for the entire class of reptiles presents us with no other instance: and he adds, "We avow indeed that to believe it, there is need that it should be attested by a person so trustworthy as M. d'Orbigny, who himself procured, in Patagonia, where, as he says, it is very common, the young specimen above alluded to. Our other examples (in the Paris Museum) undoubtedly came from Africa; two were part of the rich zoological collection made at the Cape of Good Hope by the late M. Lalande; a third was sent to the museum from Senegal, by a person attached to the administration of that colony. We know besides that M. Rüppell also found this species in Abyssinia, from which region are the two individuals deposited in the museum at Frankfort. In this species the carapace is deeply furrowed, and dentilated both before and behind. The general colour is pale yellow, deeper on the head and limbs and round the margin of the carapace. In some individuals the carapace is of a deep brown.

2107, 2108.—THE ARACHNOID PYXIS

(*Pixis Arachnoides*, Bell). In this genus the carapace is oval, very convex, and deeply notched anteriorly; the anterior part of the sternum is movable on a transverse hinge, shutting in the head and limbs when withdrawn.

This species, the only known example of the genus, inhabits India and the Indian islands; of its habits nothing is known. It is of moderate size, and beautifully marked. Head, neck, and tail brown; the limbs yellowish, with a black band; the ground-colour of the carapace reddish yellow; the plates of the disc have each eight or ten black triangular marks disposed in a radiating manner; on the marginal plates there are longitudinal marks of black, which sometimes are extended over the adjacent plates. The plastron is reddish yellow, with black marks along its lateral margin. Fig. 2107 represents the upper, Fig. 2108 the under surface of this species.

We may here observe, that, according to M. Bibron, there are twenty-seven species of terrestrial tortoise, of which six are Asiatic, three South European, nine African, and nine American. Of these one of the most remarkable is that described by Mr. Darwin, as inhabiting the Galapagos, under the title of Testudo Indica, a name given to more than one giant species. These tortoises are alluded to, so far back as 1708, by Woods, Rogers, and Courtney, in their voyage round the world (Kerr's 'Voyages,' vol. x., p. 373); who say, it is the opinion of the Spaniards that there are no others in these seas, except at the Galapagos. This species, probably the Testudo nigra of Quoy and Gaimard, he describes as being very abundant on those remote islands, as they were in Dampier's time, whose statement he quotes, that "they are so numerous, that five or six hundred men might subsist on them for several months without any other sort of provisions;" adding, "they are so extraordinarily large and fat, and so sweet, that no pullets eat more pleasantly."

The day on which Mr. Darwin visited the little craters in the Galapagos Archipelago was glowing hot, and the scrambling over the rough surface, and through the intricate thickets, was very fatiguing. "But," says Mr. Darwin, "I was well repaid by the Cyclopean scene. In my walk I met two large tortoises, each of which must have weighed at least two hundred pounds. One was eating a piece of cactus, and when I approached, it looked at me and then quietly walked away; the other gave a deep hiss and drew in his head. These huge reptiles, surrounded by the black lava, the leafless shrubs, and large cacti, appeared to my fancy like some antediluvian animals."

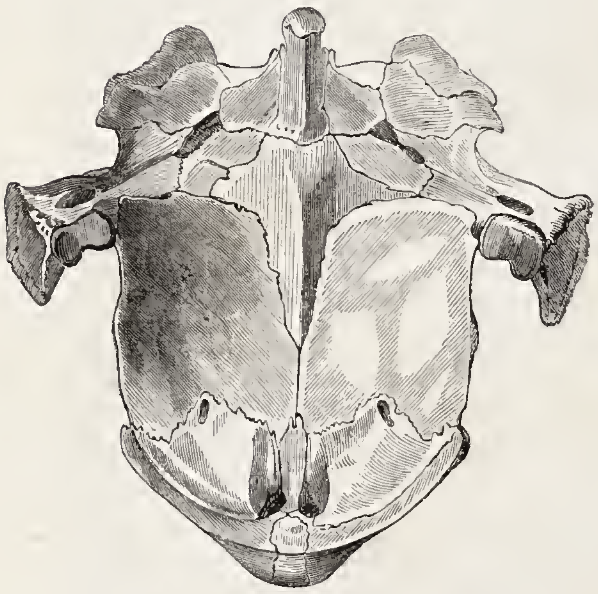
Mr. Darwin states his belief that these tortoises are found in all the islands of the archipelago; certainly in the greater number; and thus continues his description:—"They frequent, in preference, the high damp parts, but likewise inhabit the lower and arid districts. Some individuals grow to an immense size. Mr. Lawson, an Englishman, who had, at the time of our visit, charge of the colony, told us that he had seen several so large that it required six or eight men to lift them from the ground, and that some had afforded as much as two hundred pounds of meat. The old males are the largest, the females rarely growing to so great a size. The male can readily be distinguished from the female by the greater length of its tail. The tortoises which live on those islands where there is no water, or in the lower and arid parts of the others, chiefly feed on the succulent cactus. Those which frequent the higher and damp regions eat the leaves of various trees, a kind of berry (called guayavita) which is acid and austere, and likewise a pale green filamentous lichen, that hangs in tresses from the boughs of the trees.

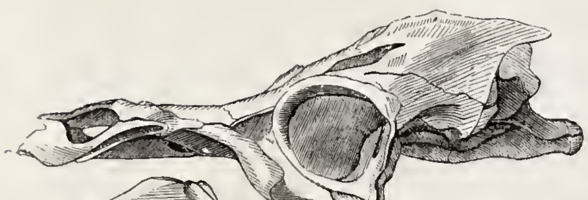
"The tortoise is very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and these are always situated towards the central parts, and at a considerable elevation. The tortoises, therefore, which frequent the lower districts, when thirsty, are obliged to travel from a long distance. Hence, broad and well-beaten paths radiate off in every direction from the wells even down to the sea-coast; and the Spaniards, by following them up, first discovered the watering-places. When I landed at Chatham Island, I could not imagine what animal travelled so methodically along the well-chosen tracks. Near the springs it was a curious spectacle to behold many of these great monsters; one set eagerly travelling onwards with outstretched necks, and another set returning, after having drunk their fill. When the tortoise arrives at the spring, quite regardless of any spectator, it buries its head in the water above its eyes, and greedily swallows great mouthfuls, at the rate of about ten in a minute. The inhabitants say that each animal stays three or four days in the neighbourhood of the water, and then returns to the lower country; but they differed in their accounts respecting the frequency of these visits. The animal probably regulates them according to the nature of the food which it has consumed. It is, however, certain that tortoises can subsist even on those islands where there is no other water than what falls during a few rainy days in the year.

"I believe it is well ascertained that the bladder of the frog acts as a reservoir for the moisture necessary to its existence: such seems to be the case with the tortoise. For some time after a visit to the springs, the bladder of these animals is distended with fluid, which is said gradually to decrease in volume and to become less pure. The inhabitants, when walking in the lower district, and overcome with thirst, often take advantage of this circumstance, by killing a tortoise, and if the bladder is full, drinking its contents. In one I saw killed, the fluid was quite limpid, and had only a *very slightly* bitter taste. The inhabitants, however, always drink first the water in the pericardium, which is described as being best. The tortoises, when moving towards any definite point, travel by night and by day, and arrive at their journey's end much sooner than would be expected. The inhabitants, from observation on marked individuals, consider that they can move a distance of about eight miles in two or three days. One large tortoise which I watched, I found walked at the rate of sixty yards in ten minutes, that is, three hundred and sixty in the hour, or four miles a day—allowing also a little time for it to eat on the road. During the breeding season, when the male and female are together, the male utters a hoarse roar or bellowing, which, it is said, can be heard at the distance of more than a hundred yards. The female never uses her voice, and the male only at such times; so that when the people hear this noise, they know the two are together. They were at this time (October) laying their eggs. The female, where the soil is sand, deposits them together, and covers them up with sand; but where the ground is rocky, she drops them indiscriminately in any hollow. Mr. Bynoe found seven placed in a line in a fissure. The egg is white and spherical; one which I measured was seven inches and three-eighths in circumference. The young animals, as soon as they are hatched, fall a prey in great numbers to the buzzard with the habits of the caracara. The old ones seem generally to die from accidents, as from falling down precipices. At least several of the inhabitants told me they had never found one dead without some such apparent cause. The inhabitants believe that these animals are absolutely deaf; certainly they do not overhear a person walking close behind them. I was always amused, when overtaking one of these great monsters as it was quietly pacing along, to see how suddenly, the instant I passed, it would draw in its head and legs, and uttering a deep hiss fall to the ground with a heavy sound, as if struck dead. I frequently got on their backs, and then, upon giving a few raps on the hinder part of the shell, they would rise up and walk away; but I found it very difficult to keep my balance. The flesh of this animal is largely employed, both fresh and salted; and a beautifully clear oil is prepared from the fat. When a tortoise is caught, the man makes a slit in the skin near its tail, so as to see inside its body, whether the fat under the dorsal plate is thick. If it is not, the animal is liberated; and it is said to recover soon from this strange operation. In order to secure the tortoises, it is not sufficient to turn them like turtle, for they are often able to regain their upright position.

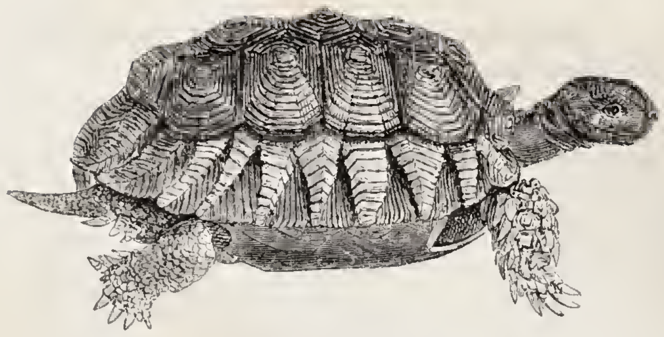
"It was confidently asserted that the tortoises coming from different islands in the archipelago were slightly different in form; and that in certain islands they attained a larger average size than in others. Mr. Lawson maintained that he could at once tell from which island any one was brought. Unfortunately, the specimens which came home in the Beagle were too small to institute any certain comparison. This tortoise, which goes by the name of Testudo Indicus, is at present found in many parts of the world. It is the opinion of Mr. Bell and some others who have studied reptiles, that it is not improbable that they all originally came from this archipelago. When it is known how long these islands have been frequented by the buccaneers, and

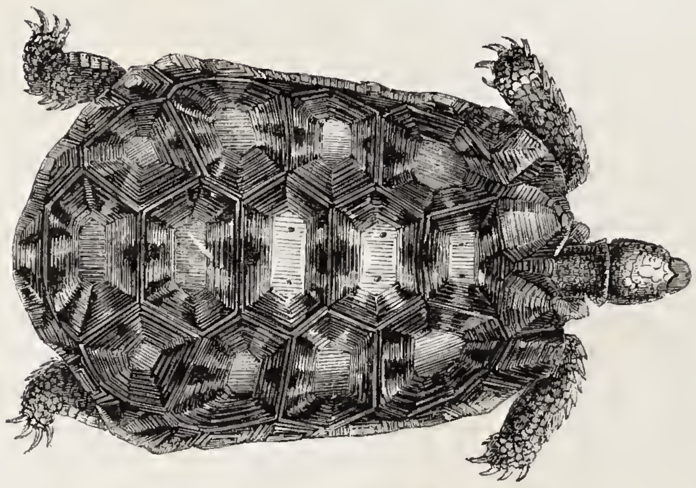

2102.—Skull of Matamata, from above.

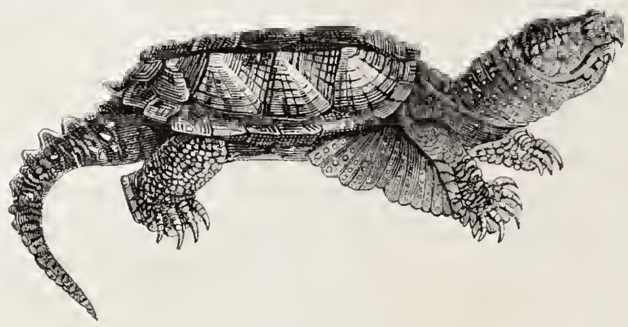

2103.—Skull of Matamata, from below.

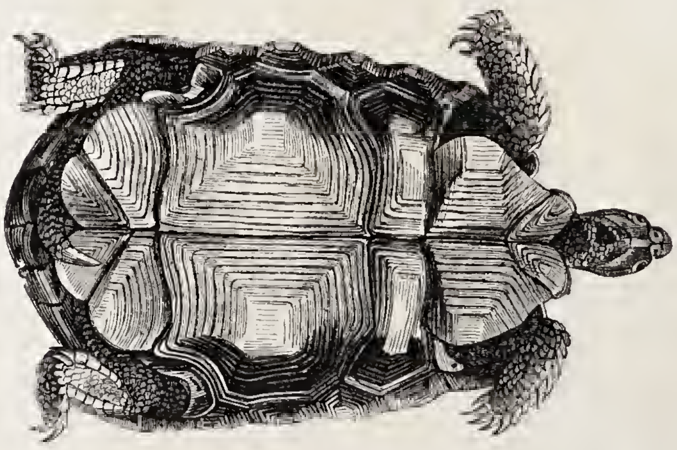

2104.—Skull of Matamata.


2105.—Skull of Matamata, back view.

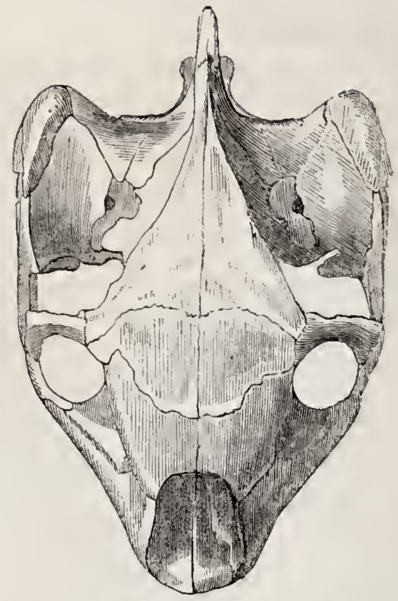

2106.—Furrowed Tortoise.

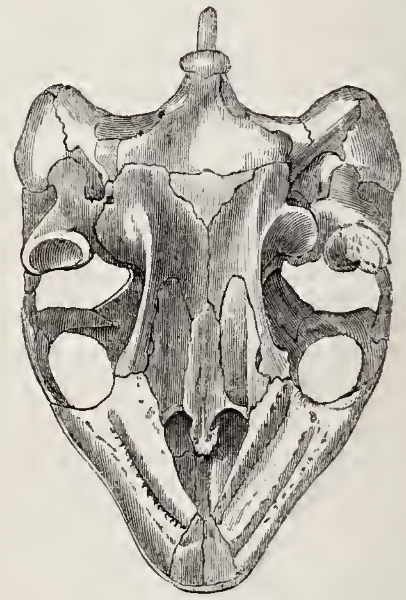

2107.—Arachnoid Pyxis, from above.

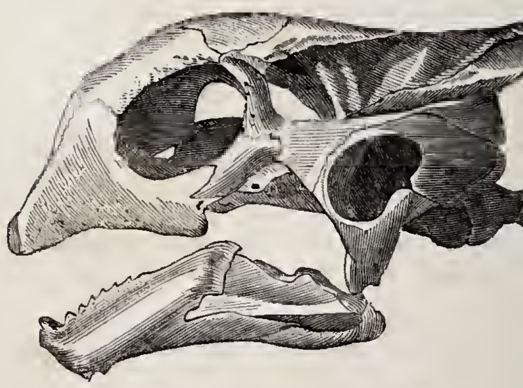

2109.—Alligator Tortoise.


2108.—Arachnoid Pyxis, from below.

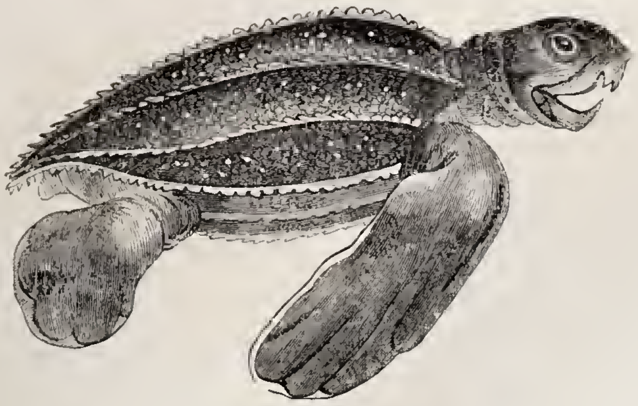

2110.—Matamata.


2099.—Skull of Indian Tortoise, from above.

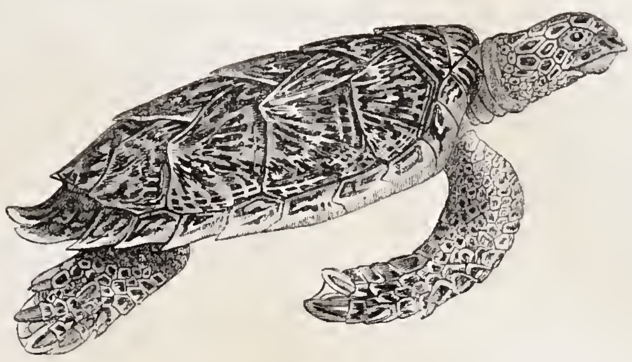

2100.—Skull of Indian Tortoise, from below.


2098.—Skull of Indian Tortoise.


2101.—Skull of Indian Tortoise.

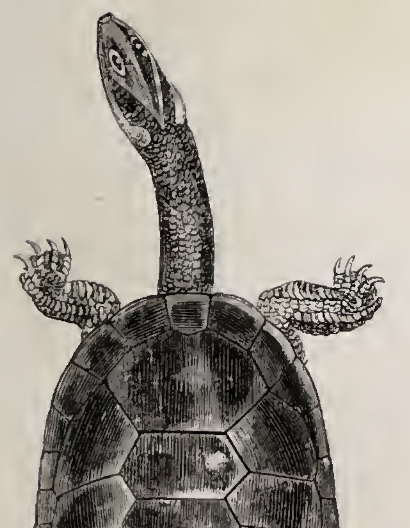


2115.—Leathery Turtle.

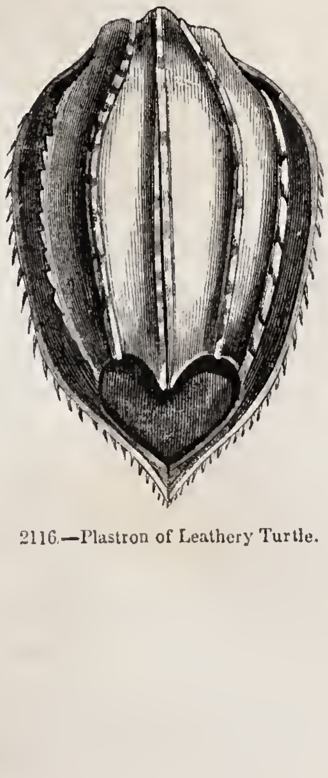


2114.—Hawk's bill Turtle.

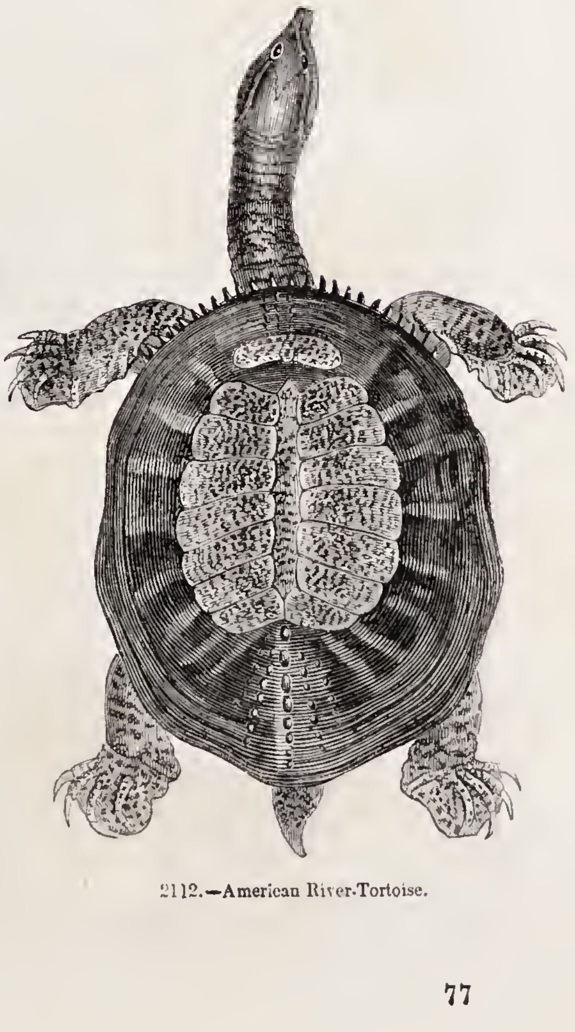
a 2113.—Catching Turtles on the Coast of Cuba. *b*



2111.—New Holland Chelodina.



2116.—Plastron of Leathery Turtle.



2112.—American River-Tortoise.

that they constantly took away numbers of these animals alive, it seems very probable that they should have distributed them in different parts of the world. If this tortoise does not originally come from these islands, it is a remarkable anomaly; inasmuch as nearly all the other land inhabitants seem to have their birthplace here."

We may now proceed to the Marsh Tortoises. The marsh tortoises form a very extensive family, and are respectively dispersed within certain latitudes, both through the Old and New World, occurring in Australia, where hitherto no terrestrial tortoise has been detected. These animals tenant swamps, lakes, ponds, and small rivers, and swim with considerable facility; on land they are more active and alert than the species of the previous family, but they never venture far from the water, which they invariably seek as a refuge from danger. The toes, instead of being buried, are developed externally, and are movable, but are united to each other by means of intervening webs of greater or less extent. The marsh tortoises are more flattened in their figure than the land tortoises, and are of an oval outline, and with the carapace and plastron less completely solidified. In young animals, indeed, the spaces between the ribs and the component parts of the plastron are separated by a cartilaginous medium, which ossifies slowly. The horny plates covering the carapace are thin, and comparatively smooth. The neck is long, as is also in many instances the tail. In some genera, as Cistudo, the plastron is attached to the carapace by a cartilaginous union, and is, besides, divided into two movable portions by a transverse hinge, so that the head, tail, and limbs, when retracted, may be completely shut up. The species so characterized are called box-tortoises. In some, on the contrary, as in Emysaurus, neither the plastron nor carapace is sufficiently developed to admit of the retraction and concealment of the head and limbs; and in others, though the limbs may be concealed, the head remains constantly exposed.

In their modes of life these marsh tortoises differ greatly from their terrestrial relatives; they are carnivorous in their habits, pursuing fishes, newts, frogs, and insects with eagerness. Some are formidable from their size and ferocity. Many, as the Painted Terrapin (Emys picta), are very beautifully marked. The females deposit their eggs in shallow excavations, which they make on the sunny banks of the waters they ordinarily inhabit; the young, when hatched, instinctively make for the stream or pool, but numbers fall a prey to birds, snakes, and small carnivorous mammalia.

The number of species, according to M. Bibron, amounts to seventy-four; viz. three European, eighteen Asiatic, six African, twenty-three South American, twenty-two North American, two Australian. To the latter, other species may now be added.

The marsh tortoises are divided by M. Bibron into two groups: viz. Cryptodera, in which the long neck, sheathed in loose skin, is capable of being completely withdrawn under the centre of the anterior margin of the carapace; and Pleurodera, in which the neck is not properly retractile, so that the head can be concealed only by the neck being folded to one side of the opening of the skull. There are other structural differences, into which we need not enter.

2109.—The Alligator Tortoise

(*Emysaurus serpentinus*). Chelydra serpentina, Schweigger. It is to the section of Cryptodera, that this extraordinary species belongs, which seems to unite in its aspect the forms of the tortoise and crocodile. Its jaws are strong and hooked; its head large, and covered with small plates; its neck long, powerful, and capable of being retracted; its limbs are thick; and the feet are armed with five robust claws before, four behind; the tail is long, and surmounted by a scaly crest, and neither this nor the limbs are capable of being retracted within the shell; along the back of the fore-limbs hangs a loose expansion of coarse granulated skin; two small barbles, or rounded excrescences, are under the chin. The plastron is small, but immovable.

The aspect of this animal is ferocious, and its character accords with its aspect; it is a native of the lakes, rivers, and morasses of Carolina, and when adult attains to very large dimensions, and is much to be dreaded. It swims with great rapidity, and pursues fish with avidity, tearing them in pieces by means of its talons. It also lurks amidst the luxuriant herbage of oozy swamps, or the reedy vegetation about the margin of rivers and lakes, ready to pounce upon aquatic birds, or other animals which come within its reach, and upon which it suddenly darts, catching them with a snap of its formidable mandibles. Mr. Bell records that he has known a stick of half an inch in diameter at once snapped asunder by the jaws of one of this species; and, as we can affirm, it is not safe to approach them unguardedly; they will not only snap at the hands, if brought too near them, but repeat the attack, with every demonstration of malice. The individual which came under our observation was very young, and only two feet six inches in length, yet, from the strength and fierceness it displayed, we were easily enabled to form an idea of the danger to be apprehended, in the case of a person, in the midst of one of the morasses of Carolina, suddenly coming in contact with an adult of large dimensions lurking in his hiding-place.

The carapace of this species is of an oblong figure, depressed with three longitudinal ridges above; the general colour is brown; the jaws and head are of an olive tint. It is the only known example of the genus.

2110.—The Matamata

(*Chelys Matamata*); Ch. fimbriata, Spix. This singular animal belongs to the section Pleurodera.

The strange appendages about the head, and the proboscis-like elongation of the nose, render this tortoise very remarkable. The head is depressed; the eyes small; the limbs strong; the nails robust; and the tail short; the snout is flexible, forming a double tube; the mouth is extremely wide; the jaws are defended by thin horny laminæ; along the back of the neck are two rows of fringed cutaneous appendages, anterior to which, on the top of the head on each side, is an ear-like membranous prolongation; two fringed membranes hang from the chin, and four others are placed across the throat. The carapace is depressed, with a longitudinal keel down the centre, and a furrow on each side of it. This species, which when adult attains to three feet in length, is a native of South America, and in particular of Cayenne; but, according to Latreille, is much scarcer there than formerly, owing to the estimation in which its flesh is held as food, an incessant persecution having been maintained against it. It is said, by this same author, to be nocturnal in its habits, and herbivorous. Such, however, is not the case; it is certainly carnivorous, inhabiting lakes and rivers, where, with its proboscis above the surface, it conceals itself amidst floating aquatic herbage, awaiting the approach of water-fowl, fishes, &c., which it seizes when within reach. It swims rapidly, and darts with great velocity on its prey. This species was first described by Bruguière, in 1792. (See 'Journal d'Histoire Naturelle.')

2111.—The New Holland Chelodina

(*Chelodina Novæ Hollandiæ*). The head and neck of the species of Chelodina remind us rather of a snake than of a tortoise, so narrow, flat, and pointed is the former, and so elongated the latter; the jaws are slender, the gape wide; the eyes vertically placed; the tail very short; the carapace depressed and oval; the plastron broad.

This singular tortoise inhabits the pools and stagnant or sluggish waters of New Holland, and is said to prey upon various aquatic reptiles, as frogs, &c. and fishes, which its long neck enables it to seize, as they approach its lurking-place, amidst aquatic herbage, or in the oozy mud. It is said to be rapid and active in its movements in the water.

Two allied species are natives of South America.

We now introduce the Fluviatile or River Tortoises. From their conformation, the fluviatile tortoises are exclusively aquatic, coming on shore only in order to deposit their eggs, and this they do stealthily by night, returning immediately to their congenial element.

The essential characters of these tortoises are thus summed up by MM. Duméril and Bibron:—"The carapace is a flexible cartilaginous expansion, forming the circumference of a centre of bone, by which it is supported; the surface of this bone, which is nearly flat, is rugose, and marked with inequalities; the ribs are free at their ends; the head is narrow and elongated; and the nose terminates in a flexible proboscis; the jaws are trenchant, and are furnished externally with folds of skin resembling lips; the eyes are prominent, placed near each other, and directed obliquely upwards. The plastron (Fig. 2093) is abbreviated posteriorly, but advances anteriorly, so as to come under the neck; it is not perfectly osseous, especially in the centre, and is united to the carapace by cartilage. The tail is short and thick; the limbs are robust, with large webbed feet; of the toes, three only on each foot are armed with nails, these are nearly straight, and channelled underneath."

To this we may add that the neck is long, and capable not only of being retracted and extended with great rapidity, but of performing lateral serpentine movements.

These tortoises are fierce and voracious, and feed upon fishes, reptiles, birds, &c., at which they dart like a pike, from their hiding-place, launching out their long neck and snapping at their prey with arrow-like rapidity. Their flesh is held in estimation, and they are taken by means of a hook and line; but so fiercely do they defend themselves, and so severely do they bite, taking out the portion seized with a snap, that the fishermen cut off their heads as soon as possible. Mr. Bell records an instance of a sailor having his finger snapped off by a trionyx (Gymnopus), which was on shipboard and ultimately placed in the Surrey Zoological Gardens.

Though these tortoises seldom come on shore, they may often be seen slumbering on trunks of floating trees, or on rocks jutting above the surface of the water; on the last alarm, however, they plunge and instantaneously disappear.

No species of this family is European. All those known to naturalists are natives of the large lakes and rivers of the warmer regions, the Nile, Niger, and other rivers of Africa; the Euphrates, the Tigris, the Ganges, &c.; and in America, the Mississippi and Ohio. They attain to gigantic dimensions.

2112.—The American River-Tortoise

(*Gymnopus spiniferus*). Trionyx ferox, Schweigger; Testudo ferox, Schœpfer. This ferocious animal is a native of the rivers of Georgia and Florida, and also in the lakes situated both above and below the falls of Niagara; it is not uncommon in the Wabash, a tributary of the Ohio, just before its junction with the Mississippi.

An aquatic tyrant, this species is a terrible destroyer not only of fish, but also of water-fowl, quadrupeds, and even young alligators, which it attacks with the utmost fury. On account of its flesh it is taken by means of a hook baited with fish, but when drawn on land it struggles desperately, darting its head right and left at its assailants with inconceivable velocity. In May the females of this species seek out some sandy spot on the river's bank, for the purpose of depositing their eggs, often crawling up very steep declivities, in order to secure a sunny aspect. The eggs, which are from fifty to sixty in number, are spherical, and very brittle. The young make their appearance in July.

An allied species (G. muticus) inhabits the same localities. The other species are Asiatic and African.

From the fluviatile we may now pass to the Marine Tortoises, or Turtles.

The marine tortoises, or turtles, are at once to be distinguished by the long paddle-like form of the limbs, of which the anterior pair are by far the most developed, and are used as oars, or rather as aquatic wings, by means of which they sail about, plough the waves, descend, or rise with the utmost address. On the land, which is only visited at certain seasons, these animals shuffle along, and with laborious efforts make only a slow progress. When turned over on their back on a flat sandy shore, they are unable, from the depression of the carapace, to recover their natural position. The marine tortoises are found in all the seas of the warm climates, but principally towards the torrid zone in the equinoctial ocean; on the shores of the Antilles, Cuba, Jamaica, the Caïman Islands, and Hayti; in the Atlantic Ocean; at the Cape de Verd and Ascension Islands; in the Indian Ocean; at the Isles of France, Madagascar, Seychelles, and Rodriguez; at Vera Cruz, in the Gulf of Mexico; and at the Sandwich and Galapagos Islands, in the Pacific Ocean. Often are they seen slumbering motionless on a calm sunlit sea, seven or eight hundred leagues from land. They have their favourite breeding-places, to which thousands periodically resort, often travelling thither from immense distances. The eggs of most of the species are excellent, but the albuminous portion, or "white," does acquire firmness by boiling. Of the estimation in which the flesh of the green turtle is held, little need be said: in our island it is a luxury, but it also forms a useful and salutary portion of the stores of vessels engaged in the commerce of the tropical and southern seas. It is the Hawksbill Turtle (Chelonia imbricata) which furnishes the horny plates, covering the carapace, known under the name of tortoiseshell.

The jaws in all the turtles are robust; the beak of the upper-jaw is hooked downwards; the edges are sharp, sometimes serrated, and the lower mandible is received into a groove of the upper. Most feed upon various marine plants, and dive to tear them up from their beds; some, however, feed upon crustacea, shell-fish, cuttle-fishes, echini, &c., as the hawksbill, loggerhead, and leathery tortoises. They exhale a musky odour. Audubon says, "The hawksbilled species feeds on sea-weeds, crabs, various kinds of shell-fish, and fishes; the loggerhead mostly on the fish of conch-shells of large size, which by means of its powerful beak it is enabled to crush to pieces, apparently with as much ease as a man cracks a walnut. The trunk (leathery) turtle feeds on mollusca, fish, crustacea, sea urchins (echini), and various marine plants."

Most, especially the leathery turtle, utter, when

entangled in nets, or when wounded, loud roars, resounding to a great distance.

Fig. 2113 represents a scene of turtle-catching by night on one of the West India Islands (*a*, the Green Turtle, Chelonia midas; *b*, the Hawksbill Turtle, Ch. imbricata).

It is on such a low sandy beach as that depicted, that the turtles deposit their eggs, taking care that they are placed beyond high-water mark. "On nearing the shore," says M. Audubon, "and mostly on fine calm moonlight nights, the turtle raises her head above the water, being still distant thirty or forty yards from the beach, looks around her, and attentively examines the objects on shore. Should she observe nothing likely to disturb her intended operations, she emits a loud hissing sound, by which such of her enemies as are unaccustomed to it are startled, and so apt to remove to another place, although unseen by her. Should she hear any more noise, or perceive any indications of danger, she instantly sinks and goes off to a distance; but should everything be quiet, she advances slowly towards the beach, crawls over it, her head raised to the full stretch of her neck, and when she has reached a place fitted for her purpose she gazes all round in silence. Finding all well, she proceeds to form a hole in the sand, which she effects by removing it from under her body with her hind-flappers, scooping it out with so much dexterity that the sides seldom if ever fall in. The sand is raised alternately with each flapper, as with a large ladle, until it has accumulated behind her, when, supporting herself with her head and fore-part on the ground, she with a spring from each flapper sends the sand around her, scattering it to the distance of several feet. In this manner the hole is dug to the depth of eighteen inches, or sometimes more than two feet. This labour I have seen performed in the short period of nine minutes. The eggs are then dropped one by one, and disposed in regular layers, to the number of one hundred and fifty, or sometimes nearly two hundred. The whole time spent in this operation may be about twenty minutes. She now scrapes the loose sand back over the eggs, and so levels and smooths the surface, that few persons seeing the spot would imagine that anything had been done to it. This accomplished to her mind, she retreats to the water with all possible dispatch, leaving the hatching of the eggs to the heat of the sand. When a turtle or loggerhead, for example, is in the act of dropping her eggs, she will not move, although one should go up to her, or even seat himself on her back; but the moment it is finished, off she starts, nor would it then be possible for one, unless he were as strong as Hercules, to turn her over and secure her."

It is at this crisis that the turtle fishery is carried on. "In spite," says Count Lacépède, "of the darkness which is chosen by the female tortoises for concealment when employed in laying their eggs, they cannot effectually escape from the pursuit of their enemies: the fishers wait for them on the shore, at the beginning of the night, especially when it is moonlight, and, as they come from the sea, or as they return after laying their eggs, they either dispatch them with blows of a club, or turn them quickly over on their backs, not giving them time either to defend themselves, or to blind their assailants, by throwing up the sand with their fins. When very large, it requires the efforts of several men to turn them over, and they must often employ the assistance of handspikes or levers for that purpose. The buckler of this species is so flat as to render it impossible for the animal to recover the recumbent posture, when it is once turned on its back.

"A small number of fishers may turn over forty or fifty tortoises, full of eggs, in less than three hours. During the day, they are employed in securing those which they had caught in the preceding night. They cut them up, and salt the flesh and the eggs. Sometimes they may extract above thirty pints of a yellow or greenish oil from one large individual; this is employed for burning, or when fresh is used with different kinds of food. Sometimes they drag the tortoises they have caught, on their backs, to enclosures, in which they are reserved for occasional use.

"The tortoise-fishers from the West Indies and the Bahamas, who catch these animals on the coast of Cuba and its adjoining islands, particularly the Caïmans, usually complete their cargoes in six weeks or two months; they afterwards return to their own islands with the salted turtle, which is used for food both by the whites and the negroes. This salt turtle is in as great request in the American colonies as the salted cod of Newfoundland is in many parts of Europe; and the fishing is followed by all these colonists, particularly by the British, in small vessels, on various parts of the coast of Spanish America, and the neighbouring desert islands.

"The green turtle is likewise often caught at sea in calm weather, and in moonlight nights. For this purpose two men go together in a small boat, which is rowed by one of them, while the other is provided with a harpoon, similar to that used for killing whales. Whenever they discover a large tortoise, by the froth which it occasions on the water in rising to the surface, they hasten to the spot as quickly as possible, to prevent it from escaping. The harpooner immediately throws his harpoon with sufficient force to penetrate through the buckler to the flesh; the tortoise instantly dives, and the fisher gives out a line, which is fixed to the harpoon, and when the tortoise is spent with loss of blood, it is hauled into the boat or on shore."

2114.—THE HAWK'S-BILL TURTLE

(*Chelonia imbricata*). Le Caret, Lacépède.

This species is well known, and much sought after for the sake of the scales of the carapace, which are the tortoiseshell of commerce; and which are cruelly separated from the living animal by presenting the convex surface to a glowing fire; as is done at Exeter Island, and other places where the fishery of this animal is carried on. It appears that after this barbarous operation the poor creatures are set at liberty, in order, as the shell grows again, that another crop of tortoiseshell may, in a future year, be taken; the second shell, however, is very thin and inferior. The eggs of this turtle are excellent, but the flesh is bad.

The hawk's-bill turtle is not only an inhabitant of the warmer latitudes of the American seas, it frequents the Islands of Bourbon, the Seychelles, Amboyna, New Guinea, and the Indian Seas. Three instances are on record of its having been captured on our shores. It attains to a large size, but seldom equals the green turtle, which often weighs three, four, or five hundred pounds, and sometimes even eight hundred, measuring six or seven feet in length.

2115.—THE LEATHERY TURTLE

(*Spargis coriacea*). Testudo Lyra, Bechst. Tortue Luth of the French.

In the genus Spargis the osseous structure of the carapace and plastron is covered with a leathery skin, instead of plates, tuberculous in the young, smooth in adults, with seven longitudinal-ridged dorsal lines, slightly serrated. The plastron has five tuberculous ridges. The paddles have no distinct nails. In the leathery tortoise the muzzle is pointed, the jaws are of enormous power, and the upper has an acute tooth-like prominence at the anterior part on each side, with a deep indentation behind, and a triangular excavation anteriorly between the two teeth, for the reception of the sharp turned-up apex of the lower jaw. The opening of the eyelids is almost vertical, and when closed the edge of the posterior (or lower) covers that of the anterior. The anterior paddles are immensely developed. This gigantic tortoise occasionally weighs from sixteen to seventeen hundred pounds, and stray individuals have been captured both on our shores and those of the adjacent continent, weighing seven or eight hundred. This species is found in the Atlantic, the Pacific, and Indian Oceans. It regularly visits the Tortugas, or Turtle islands of Florida, for the purpose of depositing its eggs, arriving there, according to Audubon, later than the other species, and being moreover less cautious in choosing a place for their concealment. The number of eggs which it deposits is about three hundred and fifty, in two sets. It is occasionally seen in the Mediterranean, and is said by Latreille to breed on the sandy shores of Barbary. When attacked and wounded, this turtle utters loud and piercing cries, which have been heard at the distance of a quarter of a league. Though very fat, the flesh is coarse and hard, and has been known to produce most severe effects in persons who have partaken of it; we cannot however affirm that it is poisonous.

Fig. 2116 represents the Plastron of the Leathery Turtle.

ORDER SAURIA (LIZARDS).

THIS order includes a vast assemblage of living beings, from the ferocious crocodile to the harmless little lizard of our copses, or the arboreal chameleon of the borders of the Mediterranean. It is in the glowing regions of the intertropics that these beings abound, a few species only, and those of small size, tenanting our latitudes.

Great is the diversity of form and habits among the Sauria: some are more or less aquatic, some arboreal, others strictly terrestrial, and a few on expanded parachutes are capable of skimming, like the flying squirrel, from tree to tree. The limbs are in general four, the figure is elongated, always terminating in a tail; the body is covered either by hard horny or bony plates, by scales, or by granulations. The eyes, excepting in certain instances, are protected by eyelids. Generally a tympanic membrane covers the external orifice of the organs of hearing. The tongue differs greatly in form: in some it is a rudiment, in some long and forked, in others fleshy; it is lubricated by a glutinous saliva. All are as a rule oviparous. The ribs are movable, and in part attached to the breast-bone (sternum); but besides these, in some the abdominal parietes are supported by a series of slender rib-like bones, free, but converging to a medial line. The mouth is armed with teeth; the lungs are extensive. Most if not all change their cuticle, and like the snake appear in brighter colours. Hybernation is general.

Family CROCODILIDÆ (CROCODILES).

Many writers regard the crocodiles as forming a distinct order, under the term Loricata (Emydosauri, Gray), in allusion to the peculiar coat of hard mail by which they are protected. "They are distinguished," says Mr. Bell, "by several important characters; of these the most tangible and obvious is that upon which the name of the order (Loricata) is founded, the covering of the whole back part of the neck, body, and tail presenting distinct series of bones of moderate size, imbedded as it were in the substance of the skin, and covered externally with a cuticle. These dermal bones are usually furnished with a crest, which renders them exceedingly strong, and they altogether form a panoply of defence which can resist the attacks of the most powerful enemies of whatever kind."

We need not say that these animals are fierce and carnivorous; they often take their prey in the water, retiring to some retreat on the shore in order to devour it, and relish it in a state of putrescence.

The tail is long, thick, muscular, and compressed; it is ridged above. The limbs are short; the anterior feet have five toes, of which the two outermost are destitute of a nail; the hinder feet have four toes more or less united by intervening webs. The head is depressed above, furrowed and rugged. The jaws are enormous, and the teeth are numerous, thick, of unequal length, of a conical figure, and hollow at the base, which receives, when implanted in the socket, the germ of the tooth destined to replace it (see Fig. 2117); they are arranged in a line at a distance from each other, the intervals mutually receiving the teeth of the opposite jaw, when both are closed. The auditory orifice is protected by a strong movable lid or valve capable of being raised or shut down at pleasure. The eyes are small, but bright, and the pupil is vertical and linear. Besides the outer eyelids there is a transparent membrana nictitans. The nostrils are seated at the extremity of the muzzle on its upper aspect; they are close together and valvular; the nasal canals do not open into the mouth, but into a post-oral space, divided from the mouth by a valvular cartilaginous expansion of the os hyoides, which is so accurately adjusted to a depending portion of the palate as completely to bound the back of the mouth; hence, if the nostrils only are raised above the water, the crocodile may keep the mouth open below or hold his prey to drown, himself breathing at ease. In the act of swallowing, the valve is drawn down by the muscles of deglutition, so as to leave for an instant the passage free, and the food, bolted in large masses, is received into the dilatable gullet. The space between the two branches of the lower jaw is muscular, covered internally with a yellow skin, full of glands, whence oozes a viscid saliva. This part represents the tongue, if indeed we may not say that this organ is wanting. Beneath the throat are two large musk glands opening externally by small orifices, whence exudes an unctuous matter, of a strong odour. It is difficult to conjecture its use.

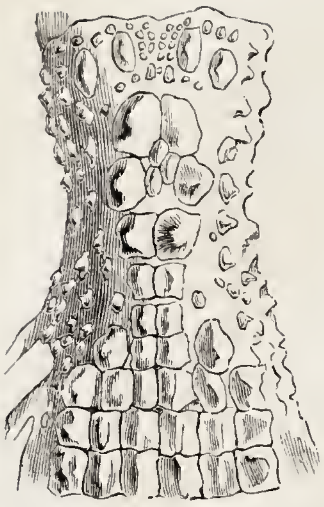
These fierce reptiles are divided into three groups or genera: Alligators or Caïmans; true Crocodiles; and Gavials.

2118.—THE PIKE-NOSED CAÏMAN OR ALLIGATOR

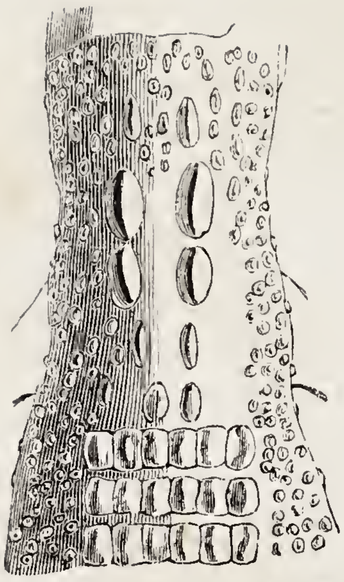
(*Alligator Lucius*). The caïmans (or caymans) are peculiar to America, and distinguished by the following characters:—the head is broad; the muzzle oblong and depressed; the teeth are of unequal length, and the fourth on each side, from the front teeth, is elongated and received into a cavity of the upper jaw when the mouth is closed: the hinder limbs are rounded and destitute of the ridged scales down the hinder margin so conspicuous in the true crocodiles, and the webs between the toes are much less developed. See Fig. 2119: *a*, the Hind Leg of the Caïman; *b*, of the Crocodile. The form of the Head is well depicted at Fig. 2120, it is of the A. Lucius.

Several species are known, distinguished among other points by the differences in the arrangement of the cervical osseous plates, which is, however, subject to certain variations even in the same species.

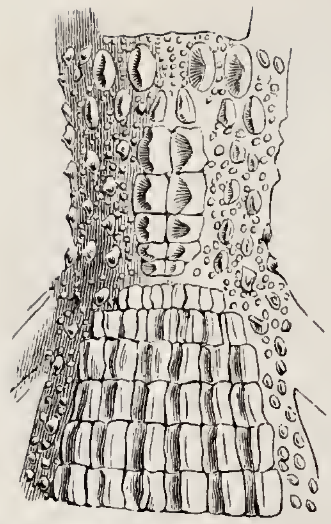
Fig. 2121 shows the Cervical Plates of the Pike-nosed Caïman (A. Lucius). Fig. 2122 those of the Jacaré (A. Sclerops). Fig. 2123 those of the Spectacled Caïman (A. Palpebrosus). Fig. 2124 those of



2124.—Cervical Plates of Spectacled Caïman.

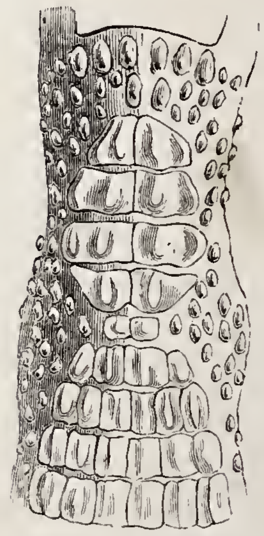


2121.—Cervical Plates of Pike-nosed Caïman.



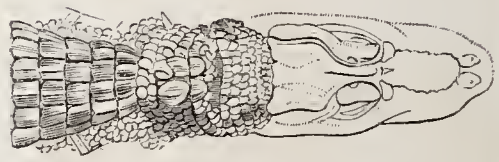
2123.—Cervical Plates of Spectacled Caïman.

2118.—Pike-nosed Caïman, or Alligator.

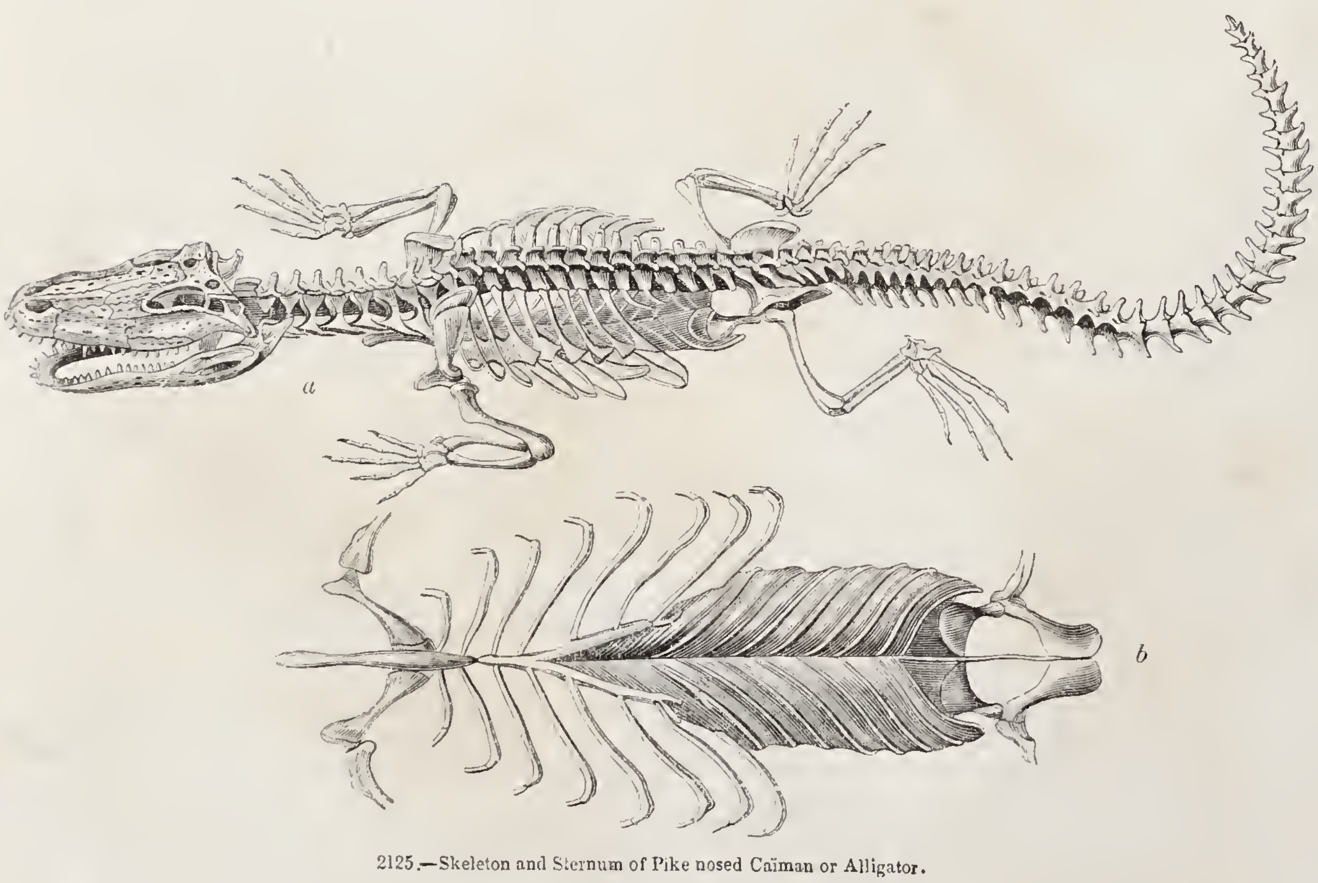


2122.—Cervical Plates of Jacaré.

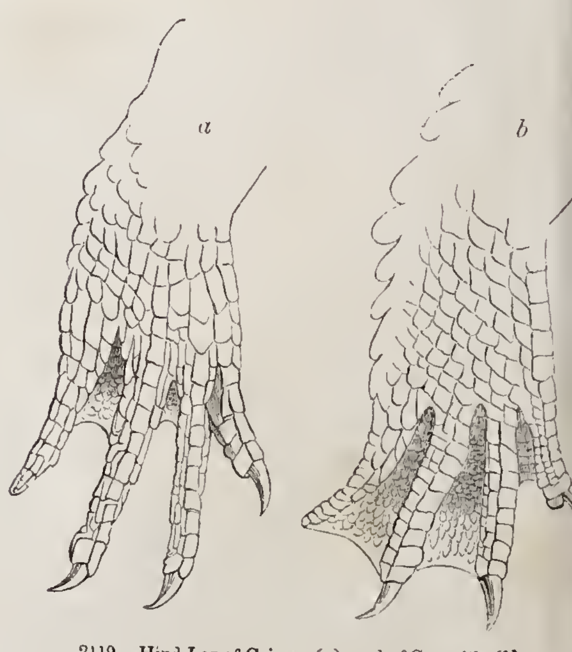
2117.—Tooth of Crocodile.



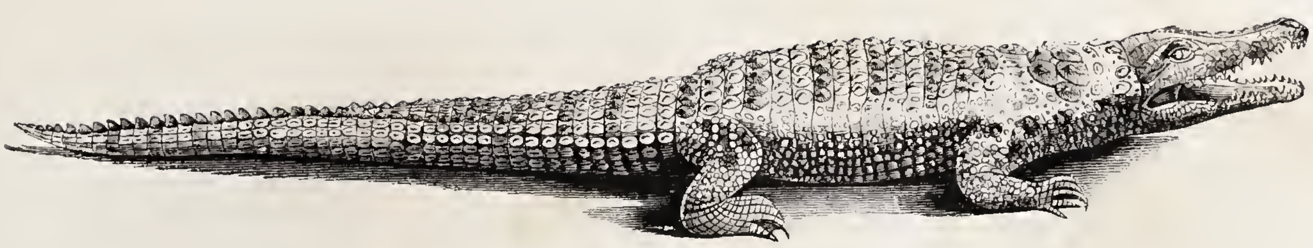
2120.—Head of Caïman.



2125.—Skeleton and Sternum of Pike nosed Caïman or Alligator.



2119.—Hind Leg of Caiman (a), and of Crocodile (b).

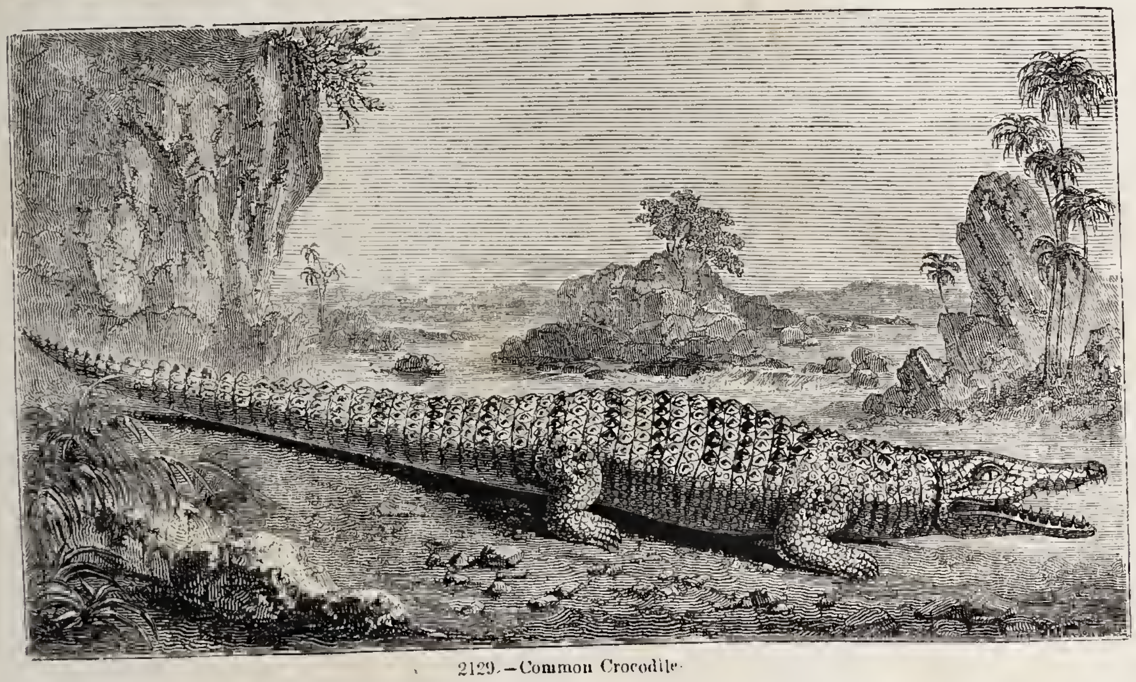


2128.—Common Crocodile.

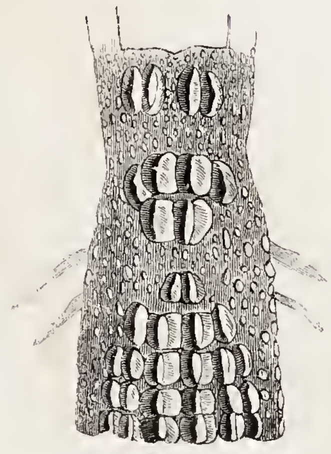
2131.—Egyptian Tumbler on Crocodile.

2132.—From Egyptian Antiquities.

2133.—From Egyptian Antiquities.



2129.—Common Crocodile.



2127.—Cervical Plates of Crocodile.

2126.—Skulls of Crocodile and Caiman.

2130.—Common Crocodile.

a variety of the Spectacled Caïman, according to M. Bibron; termed by Schneider, Crocodilus Trigonatus.

In Fig. 2125, *a* represents the Skeleton of the Pike-nosed Caïman, and well illustrates its structure, especially the peculiarity of the cervical vertebræ, with their lateral appendages, which limit the extent of motion in the head from side to side; *b*, the sternum, with the cartilages of the ribs attached to it, and the additional slender ribs supporting the abdominal parietes.

Like the rest of its genus, the pike-nosed caïman inhabits exclusively fresh waters, seldom appearing in the brackish mouths of rivers, much less venturing to cross straits of the sea from island to island, as do the crocodiles. This species, which is said to attain to upwards of twenty feet in length, is very extensively spread in North America. It is found in the Mississippi, in the lakes and rivers of Louisiana, and of Carolina, and specimens have been brought from Savannah and New Orleans. According to Bartram these formidable reptiles may be seen in troops, in creeks and bays of the river where fish abound; and he states that he saw in Florida vast numbers of alligators as well as fish, in a mineral spring near the Musquito river, though the water at its exit from the earth was nearly at the boiling point and strongly impregnated with copper and vitriol. Of all the alligators this, if we are to credit what Bartram says, is the most dangerous; it attacks both quadrupeds and men, while bathing or crossing the rivers, and is even said to prefer the flesh of the negro to all other food. We do not suppose that such diet is often obtained. It is during the night that the alligator is most active, this being the chief time in which it pursues its prey. Assembled numbers beset the mouth of some secluded creek, into which they have driven shoals of fishes, and their bellowing, not unlike that of a bull, may be heard at the distance of a mile. In order to seize the fish, they dive under the shoal, and, having snapped up a victim, rise to the surface, toss it into the air to get rid of the water, which has filled the mouth, catch it as it falls, bolt it, and renew the chase. When they happen to seize upon any animal, as a pig or dog, too large to be swallowed at once, they conceal the carcass in some hole under the bank till it begins to putrify, when they drag it forth, carry it on shore amidst the concealment of luxuriant herbage, and devour it at leisure.

When about to lay, the female excavates a deep hole in the sandy or soft bank of the river, and deposits her eggs in layers, separating each layer by means of an intervening bed of leaves, dry grass, and mud: the number is fifty or sixty: over these she watches with care, till the young are hatched, and for some months afterwards leads them about, takes care of them, and defends them from enemies. Birds and beasts of prey, however, are on the watch, and seldom more than half the brood reach the water; there they are subject to the attacks of large fishes, and even the grown males of the same species.

During the warmth of summer, these animals may be seen, indolently basking on the bank, during the middle of the day, luxuriating in the rays of the sun, or floating on the surface of the still water, with their large flat heads surrounded by the leaves of water-lilies and other aquatic plants; one perhaps every now and then will dart forwards with a roar, lashing at the same time violently with his tail, and leaving a long wake in his track. On the setting in of winter, these reptiles bury themselves in swamps and marshes under the mud, and as the cold increases sink into a lethargic slumber so profound that the severest wounds fail to rouse them to animation. They are never frozen, and the partial return of warmth for a few hours is sufficient to bring about a temporary revival.

The flesh of this and the other species is musky, notwithstanding which it is eaten by the Indians.

The true Crocodiles are tenants of Africa, India, and also of the hotter regions of America, and the islands. The muzzle is much more acute than in the alligators; the teeth are unequal, and the front teeth of the lower jaw, at a certain age, pierce the upper jaw; the fourth on each side is the longest, and is not received into a hollow of the upper jaw when the mouth is shut, but a lateral notch makes room for it. The hind-limbs have a dentelated crest on their external border; the three outer toes are entirely webbed. "Nothing," observe MM. Duméril and Bibron, "better distinguishes the crocodiles from the alligators than the narrowness of the muzzle behind the nostrils; a narrowness which is produced by the deep notch on each side of the upper mandible, serving for the passage of the fourth lower tooth." "The cranial holes are larger than in the caïmans. The nasal aperture is oval, or sub-circular. There is a very small bony plate in the substance of the upper eyelid." Fig. 2126 represents comparative views of the Skull of the Common Crocodile, and of the Pike-nosed Caïman. *a*, the Skull of the Common Crocodile, seen from above; *b*, the Skull of the Pike-nosed Caïman, in the same view; *c*, the Skull of the Crocodile, in profile; *d*, the Skull of the Caïman, in the same view. Fig. 2127 represents the Cervical Plates of the Common Crocodile.

2128, 2129, 2130.—THE COMMON CROCODILE (*Crocodilus vulgaris*). There is perhaps no genus of Reptiles, the species of which are so difficult to be distinguished from each other, as those of the present; we find, indeed, that M. Bibron distinguishes four varieties of the common crocodile, and others, described as distinct species, are to be regarded as doubtful. If the four varieties, notwithstanding their differences, be identical, the range of the common crocodile is very extensive. It is found in the Nile, the Senegal, and other African rivers; the Ganges, and the lagoons of various parts of India, and the Seychelles Islands.

The crocodile, which is by most writers regarded as the leviathan of the book of Job, was by some of the Egyptians regarded as sacred, but not, as it would appear from the statement of Herodotus, by all. His words are, "Among some of the Egyptians the crocodile is sacred, while others pursue him as an enemy. The inhabitants of the Thebais and the shores of the Lake Mœris regard him with veneration. Each person has a tame crocodile; he puts pendants of glass and gold in its ear-lids, and gives it a regular allowance of food daily. When it dies it is embalmed, and placed in the sacred repository. But the inhabitants of the territory of Elephantine eat the crocodile, not at all regarding it as sacred. This animal is not called in Egypt crocodile (κροκόδιλος), but Champsa; for the former appellation was originally applied to it by the Ionians, on account of its resemblance to a lizard so called, which they find in their hedges."

With respect to the word Champsa (χαμψα), it differs but little from the modern appellation for the crocodile in Egypt. In Coptic, it is amsah, or hamsa, which, as we learn, with the feminine article prefixed, has made the Arabic word Timsah, or Temsah, now in common use on the banks of the Nile. According to Strabo, a sacred crocodile was in his time kept in a tank, in the city called Crocodinopolis, afterwards termed Arsinoe, and attended by priests. The animal was tame, and went under the name of Suchus, or Suchis, (Σοῦχος or Σοῦχις), a word,* as it would appear, applicable only to this distinguished individual. The poor beast was fed most unnaturally. "Our host," says Strabo, "who was a person of importance, and our guide to all the sacred things, went with us to the tank, taking with him from table a small cake, some roasted meat, and a small cup of mulled wine. We found the crocodile lying on the margin. The priests immediately went up to him, and while some of them opened his mouth, another put in the cake, crammed down the flesh, and finished by pouring down the wine. The crocodile then jumped into the pond, and swam to the opposite side." Glad no doubt was the animal to escape its tormentors.

As we have stated, the crocodile was not held sacred in all parts of Egypt, but appears to have been sometimes kept tame, as is attested by one of the marbles in the Townley collection in the British Museum, which apparently represents an Egyptian tumbler, exercising his feats on the back of one of these animals. (See Fig. 2131.)

"The Egyptian notions as to sacred things seem not a little strange and contradictory; the crocodile was also one of the symbols of Typhon, the evil genius, and the murderer of Osiris. It was an Egyptian notion that Typhon assumed this form to avoid the vengeance of Horus the son of Osiris. Between Harpocrates, an Egyptian deity not mentioned by Herodotus (but known to the later Greeks by this corrupted name), and Horus, there were some points of resemblance, and hence the subjects of the bronzes (see Figs. 2132 and 2133), may refer to Horus trampling on the crocodile."—('Egypt. Antiq.')

We must not omit to notice that Herodotus, in his account of the crocodile, says, that as it so constantly frequents the water, its mouth becomes infected with *bdellæ* (βδέλλαι), which are by most scholars supposed to mean leeches; and he adds, that a small bird, called the trochilus (τρόχιλος), relieves him of these pests, boldly entering within his jaws, opened to receive the western breeze, and picking them out, while the huge beast, pleased with the service rendered, offers no injury to its little benefactor.

By M. Geoffroy St. Hilaire, these bdellæ or sucking creatures were considered to be some species of gnat, and the trochilus one of the Plover tribe; and we learn from M. Descourtils that a species of gnat infests the gums and palate of the caïmans of America.

* M. Champollion says the Egyptians gave the name of Souk to a deity represented as a man with a crocodile's head.

We learn from Pliny that the Romans first saw crocodiles in the ædileship of Scaurus, about twenty-eight years before the Christian era, and that he exhibited five. Augustus introduced thirty-six of them into the amphitheatre, where they were encountered and killed by gladiators, as an amusement to the spectators.

Though the crocodile is no longer seen in the Delta, it is abundant in the Thebaid, and the upper Nile, and in the tributary branches throughout Nubia and Abyssinia. In Dongola at the present day, it is killed for the sake of its flesh, which is regarded as a delicacy. Thevenot, who tasted crocodile's flesh in Egypt, found it good, though rather insipid.

The mode in which this powerful and ferocious animal is captured in Angola is described as follows by Dr. Rüppell, who often witnessed it. "The most favourable season," he observes, "is either the winter, when the animal usually sleeps on sand-banks, luxuriating in the rays of the sun, or the spring, after the pairing time, when the female regularly watches the sand-islands where she has buried her eggs. The native finds out the place, and on the south side of it, that is to the leeward, he digs a hole in the sand, throwing up the earth to the side which he expects the animal to take. There he conceals himself; and the crocodile, should it fail to observe him, comes to the accustomed spot, and soon falls asleep. The huntsman then darts his harpoon, with all his force, at the animal, for in order that the stroke may be successful, the iron ought to penetrate to the depth of at least four inches, in order that the barb be fixed firmly in the flesh. The crocodile, on being wounded, rushes into the water, and the huntsman retreats to a canoe, with which a companion hastens to his assistance. A piece of wood, attached to the harpoon by a long cord, swims on the water, and shows the direction in which the crocodile is moving. The huntsmen, pulling at this rope, drag the beast to the surface of the water, where it is again pierced by a second harpoon. The skill of the harpooner consists in giving to the weapon sufficient impulse to pierce through the coat of mail which protects the crocodile.

"When the animal is struck, it by no means remains inactive; on the contrary, it lashes violently with its tail, and endeavours to bite the rope asunder. To prevent this, the rope is made of about thirty separate slender lines, not twisted together, but merely placed in juxta-position, and bound round at intervals of every two feet. The thin lines get between the teeth, or become entangled about them.

"It frequently happens that the harpoons, by the pulling of the men, break out of the animal's body, and it escapes.

"If I had not seen the fact with my own eyes, I could hardly have believed that two men could drag out of the water a crocodile fourteen feet long, fasten his muzzle, tie his legs over his back, and finally dispatch him, by plunging a sharp instrument into his neck, so as to divide the spinal chord.

"The iron part of the harpoon which is used by the huntsmen is a span long, and formed towards the point like a penknife, being sharp on one edge; beyond this edge there is a strong barb, while on the back of the blade a piece projects to which the rope is fastened. This iron head is affixed to a shaft of wood eight feet in length. The flesh and fat of the crocodile are eaten by the Barabras or Berberines, who consider them excellent; both, however, have an odour of musk so strong that I could never eat crocodile's flesh without sickness following. The musk-glands of the animal form a great part of the profit which results from this capture; as the Berberines will give as much as two dollars for them, the unguent being used as a perfume for the hair.

"In some of the rivers of Africa, the negroes are bold enough, and indeed skilful enough, to combat the crocodile in his own element. Armed only with a sharp dagger they dive beneath him, and plunge the weapon into his belly. It often happens, however, that the combat is fatal to the man, and frequently his only chance of escape is to force his dagger, or if this be lost, his thumbs, into the animal's eyes, with all his might, so as to produce great pain and blindness."

Herodotus explains the mode of crocodile hunting in his time, which was managed by means of a hook, baited with the chine of a pig, while the attention of the monster was aroused by the cries of a living pig, which the fishers had with them on the shore. In anticipation of prey he dashed into the river, and meeting the baited hook instantly seized and swallowed it, and was then dragged ashore; the men then endeavoured to blind his eyes with mud, and when this was accomplished, his destruction was easy, but if not, so violent were his struggles, and so dangerous was it to approach him, that it was not without difficulty that he was dispatched.

Fish, floating carrion, pigs, dogs, and other animals surprised on the banks of the river, are the food of the crocodile; yet on land escape is by no means difficult, as the legs are ill-formed for running, and the little false ribs or appendages to the vertebræ of the neck, limiting the lateral motion of that part, render sudden turns a matter of difficulty. In the water, on the contrary, the animal is prompt and rapid; lashing his tail from side to side, he cleaves the waters like an arrow, leaving a track behind him from the impetuosity of his progress. Sometimes it is said he will dart forward into the middle of the river, uttering a loud bellowing, his eyes glaring, and his body swollen, while with his powerful tail he lashes the surrounding water, till it is worked into a foam. This exhibition of excitement ended, he darts off to his accustomed covert, and regains his concealment.

The eggs of the crocodile are of an oblong shape, hard, and somewhat larger than those of a goose; and the young, compared with their gigantic parents, are very small, but display, even at that early period, their innate ferocity. Numbers, both of young and eggs, are destroyed by beasts and birds of prey. The Ichneumon (described in vol. i., p. 214, Fig. 951) has been from an ancient date celebrated for the havoc it makes among them.

Though none of the crocodile tribe are natives of Europe, Malte Brun, in his 'Syst. Geol.,' vol. viii., p. 193, states that a crocodile is still preserved at Lyons, which was taken about two centuries ago in the Rhone, but no particulars are given. We can only account for the circumstance by supposing the animal to have wandered along the coasts of the Mediterranean from the Delta of the Nile, or perhaps from some of the rivers of north-western Africa, and have made its way into the Mediterranean.

2134.—THE GAVIAL

(*Gavialis Gangeticus*). Head of Gavial of the Ganges. Gangetic Crocodile. Crocodilus tenuirostris, Daudin; Cr. longirostris, Schn.

The Gavial, of which only one species is known, is subject to considerable variations in its progress from youth to maturity. It is characterized by the jaws being very much elongated and narrow, and somewhat depressed beak, armed with formidable teeth to the number of one hundred and eighteen or one hundred and twenty. The first and fourth tooth on each side of the lower jaw are the longest, and are received not into cavities of the upper jaw, but into conspicuous notches. This long and formidable beak sinks suddenly from the forehead, and is expanded at its extremity, where the valvular nostrils form a large oval cartilaginous mass. The eyelid contains in its substance the rudiment of a bony plate.

At Fig. 2134 are represented, *a*, the Skull of the Great Gavial, seen from above; *b*, the lower jaw; *c*, the profile of the Skull; *d*, an outline of the Head of the Gavial, covered with the integuments. There are musk glands under the lower jaw. The hind feet of the Gavial closely resemble those of the true crocodiles, but the cervical plates are arranged more nearly like those of the Caïman; forming a long band, commencing on the nape of the neck, and prolonging themselves to the dorsal plates. There is, however, some diversity, as seen at Fig. 2135, representing the cervical plates of two individuals, from Cuvier. The scales of the flanks are oval and flat, the keels of the plates, forming the dorsal cuirass, are low, but the crest of the tail is much elevated.

The Gavial is a native of the Ganges, and is the largest of the living Sauria, often exceeding twenty-five feet in length; it is one of the scourges of the river, and is very formidable from its strength and ferocity. The dying Hindoo exposed upon the bank, or the dead body consigned to the sacred waters, often become the prey of this dreaded monster.

Several species of fossil crocodile have been discovered; they belong to a distinct genera, and it is remarkable that those examples alone, which have elongated beaks, approximating to the modern Gavial, occur in formations anterior to, and including, the chalk, whilst those with a short broad snout, like that of the Caïman, appear for the first time in tertiary strata, containing in abundance the remains of Mammalia. "The discovery of crocodilean forms," says Dr. Buckland, "so nearly allied to the living Gavial, in the same early strata that contain the first traces of the Ichthyosaurus, and Plesiosaurus, is a fact which seems wholly at variance with every theory that would derive the race of crocodiles from Ichthyosauri and Plesiosauri, by any process of gradual transmutation or development. The first appearance of all these three families of reptiles seems to have been nearly simultaneous; and they all continued to exist together until the termination of the secondary formations, when the Ichthyosauri and Plesiosauri became extinct, and forms of crocodiles approaching the cayman and alligator were for the first time introduced." ('Bridgewater Treatise,' vol. i., p. 254.)

Of the long-beaked fossil forms, that which approaches the nearest to the living Gavial is the Steneosaurus, of which Fig. 2136 represents the muzzle, from a specimen procured at Havre; according to Dr. Buckland, the relics of the same species are met with in the Kimmeridge clay of Shotover Hill, near Oxford. In another fossil genus, viz. Teleosaurus, the beak is also narrow and elongated, but the nasal orifice, instead of opening upwards, terminates the anterior apex of the upper jaw, as seen at Fig. 2137. Referring to Fig. 2138, *a* represents the head of Teleosaurus Chapmanni, seen from above; *b*, the head of another individual of the same species, seen from below, showing the lower jaw; *c*, an inside view of the extremity of the lower jaw. This species is found in the lias, in the neighbourhood of Whitby, and in the great oolite of Oxon.

In Crocodilus Spenceri (Fig. 2139), the skull approaches closely to that of the caïmans, and is broad with a short and heavy snout. It is found in the London clay of the Isle of Sheppey.

We shall here leave the crocodiles, the family Crocodilidæ of some authors, the order Emydosauri of De Blainville, Mr. Gray, and others, and advance to the true Sauria, which appear to emerge gradually through a series of forms to the Ophidia (or Snakes), or at least to approximate towards them. Of the various systematic arrangements of the true sauria, none appear to us so clear and simple as the one given by that eminent naturalist Mr. Gray, in the 'Synopsis of the Contents of the British Museum' (1840). But at the same time we must not omit an express notice of the admirable 'Erpétologie Générale,' of MM. Duméril and Bibron, one of the standard works on reptiles of the present day, to which we shall often have occasion to refer.

Before we enter upon our subject, however, it may be as well to allude to an old superstition, which, under various phases, has passed from the pages of Pliny, Dioscorides, Solinus, Ælian, and others, to those of the naturalists of the last century. Who has not heard of the basilisk or cockatrice, the king of serpents, with a regal crown upon its head, blighting the herbage with its breath, and striking dead with a glance of its eye?

It would appear that several sorts of these creatures, "bodied forth" by imagination, were supposed to exist, all "monstra horrenda;" and one, the concentration of evil, was said to be produced from the eggs of extremely old cocks, hatched under toads and serpents. This parentage, indeed, is attributed by some to the whole brood. Pliny, after stating that this creature kills with a glance of the eye, adds that "the Cyrenaic Province produces him, of the size of not more than twelve fingers, and remarkable for a white spot like a diadem on his head. He drives away all serpents by hissing; nor does he impel his body like the rest by a multiplied flexion, but advances lofty and elevated. He kills the shrubs not only by contact, but by breathing on them, scorches up the green herbage, and splits the rocks, such power of evil is there in him. It was formerly believed that if killed by a spear from on horseback, the virulence of the poison, conducted through the weapon, destroyed not only the rider but the horse also."

Johnston, who enters very gravely into all the evil qualities of this basilisk, doubts the possibility of its asserted mode of production, but he and others of our earlier writers believed in its existence. "Yet was the basilisk mortal, and had foes proof against its fatal glance and withering breath. Of these one was the weasel; this animal feared not the encounter, and when bitten or hurt in the combat, it would retire, and eat some rue, the only herb which the monster's breath could not dry up, and again return to the charge, and never cease the conflict till it had stretched its enemy dead." Another dreaded animal was a cock, for though sprung from the egg of such a bird, mirabile dictu, no sooner did it hear "the cock's shrill clarion," than it instantly expired. We present our reader with two representations of basilisks or cockatrices, from Aldrovandus, one of which he owes to Grevinus. Fig. 2140, Basiliscus in Solitudine Africæ vivens; the basilisk inhabiting the deserts of Africa. Fig. 2141, Basiliscus, sive Regulus, Grevini. The basilisk, or kinglet, of Grevinus.

We have said enough about a fable utterly unworthy of our serious notice. The title basilisk, or basiliscus, is applied by modern naturalists to a genus peculiar to South America.

Family CHAMÆLEONIDÆ (CHAMELEONS).

These singular reptiles, which are distributed to Africa, India and its islands, the Seychelles Islands, Bourbon, and Mauritius, Australia, &c., but not America, as far as is at present ascertained, may be distinguished by the deep compressed form of the body, surmounted by an acute dorsal ridge; by the toes, which are united together as far as the last joint, and armed with sharp claws, being disposed in two sets, antagonizing with each other, three being placed anteriorly, two posteriorly, and forming, like the foot of the parrot, efficient graspers; by the surface of the skin being covered, not by scales, but by minute horny granules; and by the prehensile power of the tapering tail. The head, we may add, is large, and from the shortness of the neck, seems as if set upon the shoulders; it is somewhat wedge-shaped in figure, being broad across the occiput, which is surmounted with an elevated crest or casque, in some species greatly developed; an abrupt ridge overtops both eyes, extending thence to the muzzle, where each ridge meets. The mouth is very wide, and the jaws are armed with small trilobed teeth. The tongue is a most extraordinary organ, and is the instrument by means of which the animal takes its insect prey. It consists of a hollow tube, with a fleshy tuberculated apex, and is capable of being darted out instantaneously to a great distance, and as instantaneously retracted. When retracted it folds up within itself, somewhat after the manner of a pocket telescope; it is lubricated by a glutinous saliva, and when fully extended is vermiform in appearance. So rapidly does the animal launch this instrument at a fly, or other insect, or at a drop of water on a leaf or twig, and so rapidly is it withdrawn, that the eye can but just follow the movement.

The eyes of the chameleon have a singular and odd expression. They appear mere points: the whole of the anterior portion of the ball, excepting the pupil, being covered with skin, forming a single circular eyelid. The balls thus covered with skin, to which they are attached, are set each in a large orbit, with a deep furrow around them, and roll about, perfectly independent of each other; so that the axis of one eye may be directed backwards, forwards, upwards, or downwards, and that of the other in a contrary direction, the animal making two distinct surveys at the same moment, thus producing a grotesque effect.

We have heard of the chameleon's food being the air; it lives, however, on more substantial diet; but this story may have arisen from the following circumstance:—the lungs are exceedingly voluminous, and these the creature is able to fill with air, so as to puff itself up, and in this state it often remains for hours without any movement of respiration being perceptible; on exhausting the lungs of the air, the sides of the body fall in, and the frame has a meagre appearance till the lungs are again inflated, when it becomes suddenly bloated as before. Certain continuations of these lungs penetrate the numerous cellules into which the abdominal cavity is regularly divided, while others penetrate under the skin between the muscles, to which the former adheres only by lax membranes, especially on the spine, down the centre of the under parts, and on the limbs and tail.

It may be asked,—Are not the changes in the colour of the skin, for which the chameleon has been long celebrated, dependent in some degree on the respiration and differences of condition in the lungs? Barrow indeed declares, that previously to the chameleon's changing colour, it makes a long inspiration, swelling out twice its usual size, and that as the inflation subsides the change of colour gradually takes place, the only permanent marks being two small dark lines passing along the sides. From this account some have ascribed the transitions of tint to the influence of oxygen on the fluids and tissues of the body; and there is much appearance of probability in the theory.

Dr. Weissenborn attributes these changes to the varied influence of light on the nervous system.

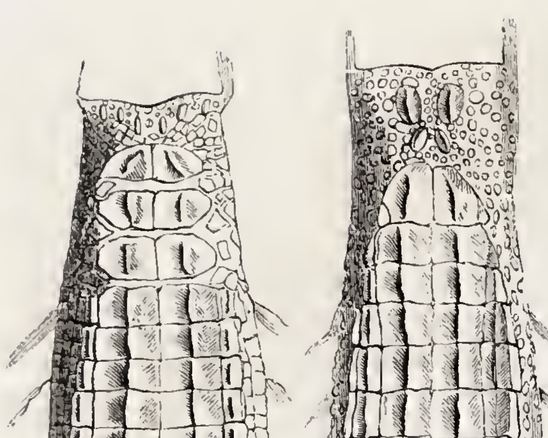
The following is M. Milne Edwards's theory, which after all does not leave the subject completely explained. See 'Ann. des Sciences, Nat.,' Jan., 1834. The results of his observations are:—

1. "That the change in the colour of chameleons does not depend essentially either on the more or less considerable swelling of their bodies, or the changes which might hence result to the condition of their blood or circulation; nor does it depend on the greater or less distance which may exist between the several cutaneous tubercles; although it is not to be denied that these circumstances probably exercise some influence upon the phenomenon.

2. "That there exist in the skin of these animals two layers of membranous pigment, placed the one above the other, but disposed in such a way as to appear simultaneously under the cuticle, and sometimes in such a manner that the one may hide the other.

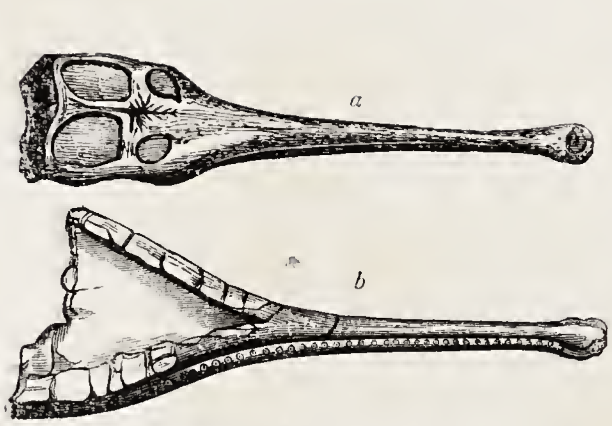
3. "That everything remarkable in the changes of colour which manifest themselves in the chameleon may be explained by the appearance of the pigment of the deeper layer to an extent more or less considerable, in the midst of the pigment of the superficial layer; or from its disappearance beneath this layer.

4. "That these displacements of the deeper pig-



2135.—Cervical Plates of Gavials.

2141.—Basilisk of Grevinus.



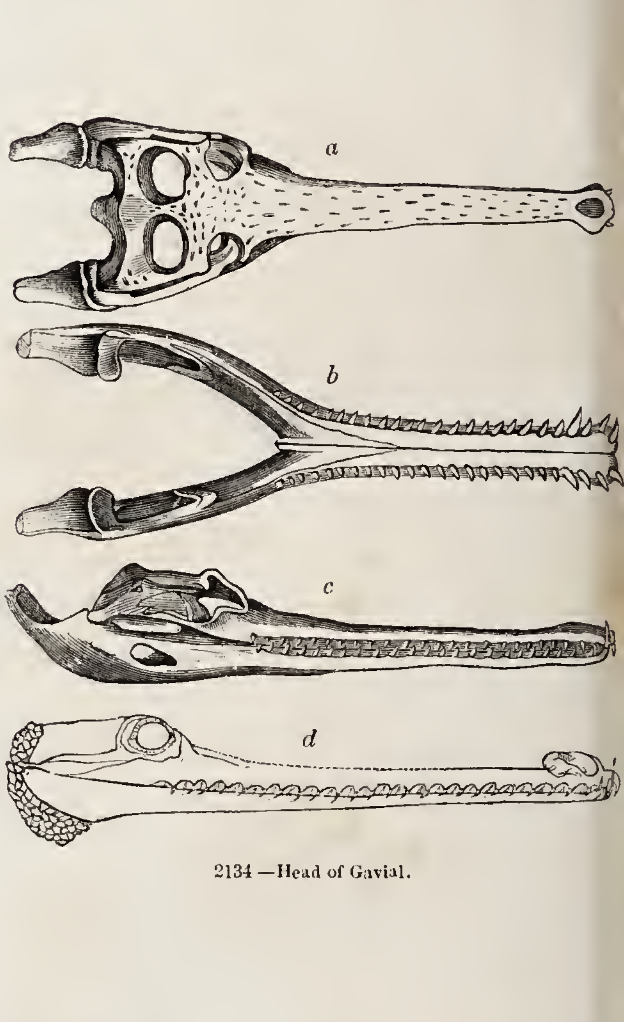
2138.—Heads of Teleosaurus. Fossil.

2137.

2140.—Basilisk from Aldrovandus.

2144.—Common Chameleon.

2145.—Skulls of Fork-nosed Chameleon.

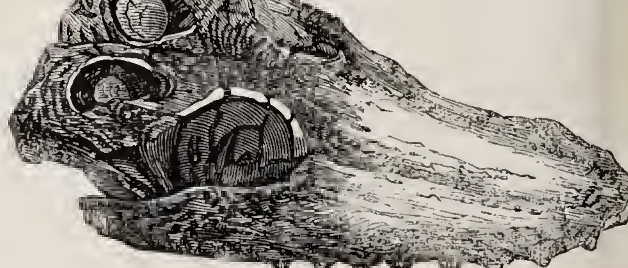


2134.—Head of Gavial.

2143.—Head and Tongue of Chameleon.

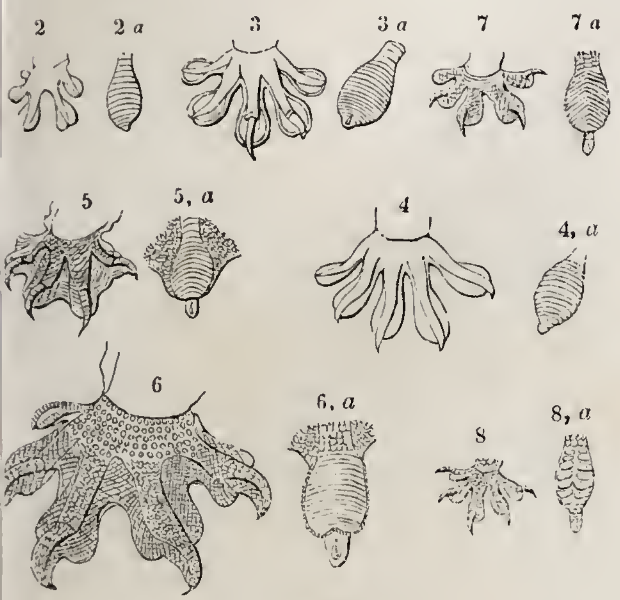
2136.—Muzzle of Steneosaurus. Fossil.

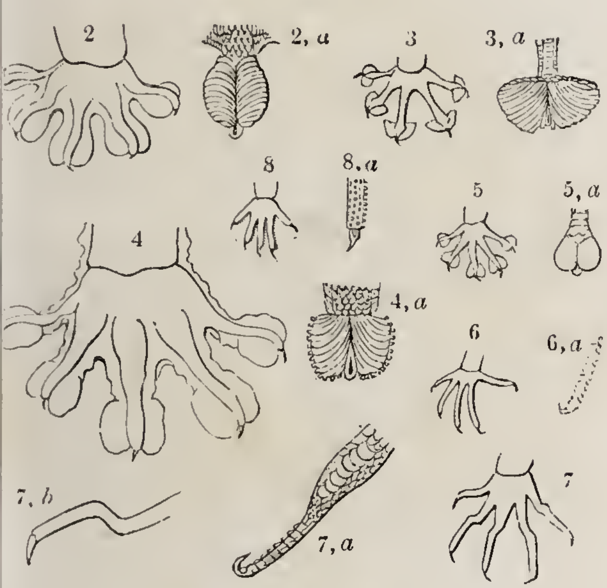
2142.—Skeleton of Chameleon.

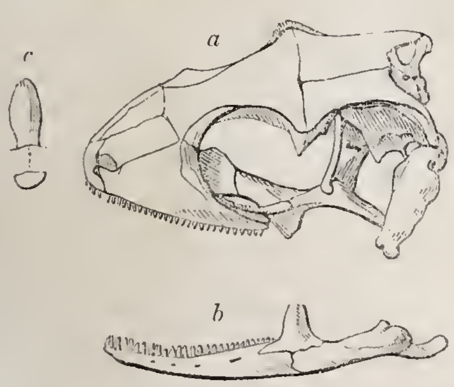


2139.—Skull of Crocodile. Fossil.


2151.—Egyptian Gecko.


2147.—Feet of Geckos.


2148.—Feet of Geckos.


2146.—Skull of Gecko.


2153.—Banded Gecko.


2152.—Milius's Gecko.


2150.—Seychelles Gecko.


2149.—Smooth-headed Gecko.

ment do in reality occur; and it is a probable consequence that the chameleon's colour changes during life, and may continue to change even after death.

5. "That there exists a close analogy between the mechanism by the help of which the changes of colour appear to take place in these reptiles, and that which determines the successive appearance and disappearance of coloured spots in the mantles of several of the cephalopods."

How the mechanical admixture of two pigments can produce the various tints, exhibited at different times by the skin of the chameleon, as primary yellow and red, yellowish grey, brown and violet, or dull inky blue, is not very clear. Must not the pigments themselves change colour? We think so.

The skeleton is remarkable for the strong spinous processes of the vertebral column; the number of the cervical vertebræ is only five (the majority of Sauria having eight); it is represented at Fig. 2142.

Fig. 2143 represents the Head and Tongue of the Chameleon in the act of taking prey.

As all its form indicates, the chameleon is arboreal in its habits; it traverses the twigs and branches in a slow and cautious manner, clinging by the tail, and grasping with its feet; on the ground its motions are awkward and irresolute, and it gropes about, using its limbs in succession rather than in pairs.

We have had abundant opportunities of observing the chameleon in captivity, and cannot say that it is very attractive. It is slow and inanimate, ever seeking the warmth of the sun, in the rays of which it will bask for hours together, changing its tints as evening draws on, and assuming with darkness a dusky hue. In a hothouse, it will live among the plants, as if in a state of perfect liberty, but never displays any intelligence or activity.

The female digs an excavation in the ground for the reception of her eggs, and covers them with earth and dried herbage. The eggs are numerous, and oval, and covered with a tough semicalcareous sort of parchment.

2144.—The Common Chameleon

(*Chamæleon vulgaris*). This species is a native of Egypt, and the northern line of Africa, and also the southern districts of Spain and Sicily. It was well known to the ancients, and is the χαμαιλέων of Aristotle.

A distinct variety, or nearly allied species, inhabits India.

Dr. Weissenborn, who had a chameleon for some months in his possession remarks, that of all the circumstances connected with the variations of its colour, none were more surprising than the difference between the tint of one side of the body and that of the other at the same time; and he attributes this to separate galvanic or nervous currents, directed independently of each other to the two sides of the body.

His words are: "The remote cause of the difference of colour in the two lateral halves of the body may be distinctly referred to the manner in which the light acts upon the animal. The statement of Murray, that the side turned towards the light is always of a darker colour, is perfectly true; this rule holds good with reference to the direct and diffused light of the sun and moon as to artificial light. Even when the animal was moving in the walks of my garden, and happened to come near enough to the border to be shaded by the box edging, that side so shaded would instantly become less darkly coloured than the other. Now, as the light in these cases seldom illumines exactly one half of the animal in a more powerful manner than the other, and as the middle line is constantly the line of demarcation between the two different shades of colour, we must evidently refer the different effects to two different centres, from which the nervous currents can only radiate, under such circumstances, towards the organs respectively situated on each side of the mesial line. Over these centres, without doubt, the organ of vision immediately presides; and indeed we ought not to wonder that the action of light has such powerful effects on the highly irritable organization of the chameleon, considering that the eye is most highly developed. The lungs are but secondarily affected, but they are likewise more strongly excited on the darker side, which is constantly more convex than the other.

"Many other circumstances may be brought forward in favour of the opinion that the nervous currents in one half of the chameleon are going on independently of those in the other; and that the animal has two lateral centres of perception, sensation, and motion, besides the common one in which must reside the faculty of concentration. Notwithstanding the strictly symmetrical structure of the chameleon, as to its two halves, the eyes move independently of each other, and convey different impressions to their different centres of perception: the consequence is, that when the animal is agitated, its movements appear like those of two animals glued together. Each half wishes to move its own way, and there is no concordance of action. The chameleon therefore is not able to swim like other animals: it is so frightened if put into water, the faculty of concentration is lost, and it tumbles about as if in a state of intoxication. On the other hand, when the creature is undisturbed, the eye which receives the strongest impression propagates it to the common centre, and prevails upon the other eye to follow that impression and direct itself to the same object. The chameleon moreover may may be asleep on one side and awake on the other. When cautiously approaching my specimen at night, with a candle, so as not to awaken the whole animal by the shaking of the room, the eye turned towards the flame would open and begin to move, and the corresponding side to change colour, whereas the other side would remain for several seconds longer in its torpid and changeable state with its eye shut." (See 'Magazine of Natural History,' October, 1838, p. 532.)

These views of Dr. Weissenborn are worth consideration; fuller details will be found in the work referred to.

Fig. 2145 represents the Skull, in two views, of the Fork-nosed Chameleon (Chameleon bifidus). A native of the continent of India, the Moluccas, Bourbon, and also of Australia. The top of the head is flat, the muzzle is prolonged into two distinct branches, which are compressed and dentelated along the upper and under margins. In its general manners this strange species agrees with the rest of its congeners, and we cannot imagine the end to be answered by the singular conformation of the snout.

Family GECKOTIDÆ (GECKOS.)

Like the Chameleons, the Geckos form a distinct and very natural family. They are reptiles of small size, but of repulsive aspect, and of nocturnal habits; from the structure of the toes they are capable of running along the smoothest surfaces, up walls, and even, like a fly, of traversing ceilings; they lurk in the chinks and fissures of walls and trees, in holes and crannies, under the broad leaves of trees, and in some countries infest the habitations of man. They are universally distributed through every quarter of the globe, but are most numerous in the warmer climates of Asia. Two species are common in southern Europe, and occur also in northern Africa. The species are numerous.

We have said that the aspect of these lizards is uncouth. The head is large and flat, the neck short, the body thick and depressed, without any dorsal ridge; the limbs are short and stout, the toes are of almost equal length, flattened, and expanded beneath, and transversely laminated, or furnished with imbricated suckers, by means of which they adhere firmly in any position; and the claws are sharp, hooked, and retractile, like those of a cat. The eyes are large, full, and bright, generally with a narrow linear festooned pupil, which expands at night. The eyelids are little developed, while the eyes have a staring glance. The orifices of the ears are placed on the sides of the head, the tympanic membrane being considerably below the surface, and the orifice bordered by two folds of skin. The tongue is large and fleshy, but slightly protractile, and its free extremity is either notched or rounded. The teeth are small, equal, compressed, with cutting edges, and implanted in the internal aspect of the jaws. There are no palatal teeth; the mouth is wide. The skin is granulated, and often beset with scattered tuberculous scales; and the limbs, the sides of the body, and tail, are sometimes fringed with dentelated or vandyked membranes. In the males generally, and often in the females, there is a line of pores (femoral pores) on the inside of each thigh, and across the lower part of the abdomen. The tail is variable in length, but never exceeds that of the body.

The tints of these reptiles are mostly blended greys and browns; but it would appear that, as in the chameleons, they are capable, to a certain extent, of changing their hues, transient shades of blue, red, and yellow appearing and disappearing at the creature's will; and, according to Wagler, certain Indian species become luminous or phosphorescent during the night. From the flatness and flexibility of the body, these reptiles are capable of insinuating themselves into the smallest crevices, and their sombre hues blending into and harmonizing with the shadowy obscurity in which they are, so to speak, enveloped during their hours of retirement, tend to their concealment. They offer nothing to attract the eye, no movement, no brilliant colour.

At night they come forth all alive in quest of insect prey, ever and anon uttering their clucking cry, whence the imitative name Gecko, and also *Tockaie* and *Geitjé*. Their bright eyes glare; they traverse craggy rocks, old walls, and the rough trunks of trees, exploring every crevice; they lurk in ambush, and dart from their concealment upon their victim; they appear and vanish as if by magic; we see them, and the next moment they are gone. Confident in their powers, they boldly await approach, their eyes gleam, and their fixed gaze seems to bid defiance; you raise your hand to strike or seize them; where are they? not a rustle was heard, not the slightest noise, and yet they have disappeared. Thus endowed, and of forbidding aspect, we can scarcely wonder at the aversion entertained towards these reptiles in the countries they tenant. They are regarded as being extremely venomous, and it is believed that even their touch occasions malignant disorders of the skin, while their saliva is most dreadfully noxious. They are reported to poison viands of any kind over which they may crawl, rendering such highly deleterious. It often happens that in these popular errors there is some degree of truth. The toad, for example, is said to be venomous, and there is some degree of truth in the assertion. The cutaneous glands pour forth an irritating acrid secretion, and several times have we seen a dog seize one of these creatures, but instantly drop it, and retreat shaking his head, while the foam filled his mouth and ran down the jaws, his distress lasting for half an hour; a favourite spaniel of ours was once served this trick, but nothing would induce him afterwards to approach such "varmint," though he would kill a rat in an instant.

So it is with these calumniated geckos; their sharp clinging claws, and the suction of their toe-pads, acting like little air-pumps, will really produce redness on a delicate skin, and it is not unlikely that an irritating secretion may contribute to this besides, combining with the slight puncture of the claws and the suction of the pads, to produce marks for some time permanent: this is the key-note to the strain of the horrible which runs current.

Like many other lizards, our own pretty little common lizard (Zootoca vivipara) for instance, the geckos have the singular power of reproducing their tail when lost by accident. The tail, indeed, is very brittle, and when broken off it is soon renewed, but a swelling marks the line where the reproduced member commences; many such examples in the different species of gecko have come under our personal notice.

The Gecko, or rather one species, was well known to the ancients, and it is generally admitted that it was the lizard described by Aristotle under the name of Ascalabus or Ascalabotes (ἀσκάλαβος, sive ἀσκαλαβώτης), and by Pliny under that of Stellio. This opinion was supported by the learned Gesner, who has shown that under the names of Ascalabotes and Galeotes, both Aristotle and Theophrastus spoke of the little lizards, which in his time the Italians designated by the name of Tarentola, and which are characterized by a short squat body, climbing the walls of buildings and the sides of rooms in quest of spiders, on which they feed. Schneider, who has published an express dissertation on the subject, has satisfactorily demonstrated the identity of the Stellio of Pliny with the Wall Gecko of southern Europe and northern Africa (Platydactylus muralis, Bibr.; Lacertus facetanus, Aldrovand).

Fig. 2146 represents the Skull of the Gecko: *a*, the cranium; *b*, the lower jaw; *c*, a tooth enlarged.

The geckos are divided into various genera according to the structure of the feet, of which some of the principal forms are displayed at Figs. 2147 and 2148.

In these representations the object marked with the numeral only displays the foot, those with the letter *a* added exhibit the structure of the lower part of the toe. Fig. 2147: 2, Platydactylus cepedianus; 3, Platydactylus Ægyptiacus; 4, Platydactylus guttatus (Gecko verus, Common Gecko of Gray); 5, Platydactylus homalocephalus (Ptychozoon of Kuhl, Pteropleura of Gray); 6, Platydactylus Leachianus (Ascalabotes Leachianus, Griff. An. Kingd.); 7. Hemidactylus oualensis (Peropus, Weigmann); 8, Hemidactylus triedrus.

Fig. 2148: 2, Thecadactylus theconyx; 3, Ptyodactylus Hasselquistii (P. guttatus, Rüppell); 4, Ptyodactylus fimbriatus; 5, Phyllodactylus porphyreus; 6, Gymnodactylus scaber (Stenodactylus, Rüppell; Cyrtodactylus, Gray); 7, Gymnodactylus pulchellus; 7 *b*, the claw of the latter in profile.

2149.—The Smooth-headed Gecko

(*Platydactylus homalocephalus*). This singular reptile is a native of Java, and is remarkable for a free membrane which borders the sides of the head, the sides of the limbs, body and tail, and which is deeply vandyked or indented on the latter. The general colour above is brown, with a yellower tint down the back, which is divided at equal distances by black wavy lines, while a zigzag line encircles the top of the head; the membranes and under parts are whitish. Of its habits nothing is

known. The femoral pores of the male of this species are exhibited at *a*.

2150.—THE SEYCHELLES GECKO

(*Platydactylus Seychellensis*). As its name implies, this reptile is a native of the Seychelles Islands, and is a rare species in museums. It is remarkable for the thickness of the limbs, and the magnitude of the eyes. The suckers of the toes are much expanded, and transversely lamellate. Its general colour is yellow, with a series of chestnut coloured spots on each side of the back, which sometimes run into each other. Of its habits no details have been received.

2151.—THE EGYPTIAN GECKO

(*Platydactylus Ægyptiacus*). This species, which is closely allied to the common wall gecko of Southern Europe and Northern Africa, but differs in many minor points, and particularly in having the tubercles with which the skin of the upper surface is studded, at greater distances from each other, and without any ridge. It appears to be confined to Egypt, inhabiting the fissures and holes of ruined buildings, and often intruding itself into the rooms of inhabited houses, coming from its lurking-place at night, and traversing the walls and floors in quest of flies and spiders.

2152.—MILIUS'S GECKO

(*Gymnodactylus Miliusii*). This species is a native of New Holland, but we have no definite account of its manners; its general colour above is chestnut, with white transverse streaks; the skin is beset with conical tubercles. Femoral pores wanting.

2153.—THE BANDED GECKO

(*Diplodactylus vittatus*, Gray). Phyllodactylus vittatus, Bibron.

This reptile is a native of New Holland, and was first described by Mr. Gray in the 'Proceeds. Zool. Soc.' 1832, p. 40. The length of the head and body is two inches, that of the tail one and a quarter inches. On each side of the body there are two rows of rather distant small spots, which become larger on the upper surface of the tail, and scattered on the limbs. General colour brown, with a broad longitudinal fillet of a deeper tint, sides tile-red; limbs and tail margined with rows of yellow spots.

Family IGUANIDÆ (IGUANAS).

The present family is very extensive, containing upwards of forty-six genera, and of one hundred and fifty species.

The body is covered with scales, or horny plates, or tubercles, often ridged or spinous, but never osseous. As a general rule there is a horny crest or ridge extending along the middle line of the back and tail; the abdominal plates are large and square. The tongue is thick, spongy, velvety on its surface, free at its tip. The eyes are defended with movable eyelids. The toes are free, distinct, and armed with nails. The auditory orifice is generally apparent, and often encircled by pointed scales.

The Iguanidæ are divided into two sub-families by MM. Duméril and Bibron; termed Pleurodonta (πλευρὸν, a side, and ὀδοὺς, ὀδόντος, a tooth), and acrodonta (ἄκρος, the ridge or summit). The Pleurodontous Iguanidæ are, with the exception of one genus (Brachylophus, an Indian group) all restricted to America, and are characterized by the teeth not being implanted in the ridge of the jaw, but in a furrow along the side of the jaw, to which they adhere by one side of the bony substance of the root, without being rooted into the jaw itself.

The Acrodontous Iguanidæ are natives of Asia, Southern Europe, Africa, and Australia; and are distinguished by the teeth being seated on the ridge of the jaws, to which they are soldered, and of which they appear to be a continuation.

These peculiarities of structure, says M. Duméril, present a remarkable concordance with the geographical distribution of the groups: yet it must be acknowledged that the disposition of the teeth is not to be easily ascertained all at once, for it is almost impossible to open the jaws of the animals while alive, and almost equally so when preserved in spirits after death. Besides, in order to ascertain the manner in which the teeth are fixed, it is often necessary to cut away a portion of the gum, in order to lay bare the furrow, where it exists, or to become assured of its absence."

A few of the Pleurodontous Iguanidæ will first engage our notice; of these we shall first advert to the true Iguanas, or Guanas.

The restricted genus Iguana contains but three distinct species, which attain to considerable dimensions, and have a fierce and strange aspect, though their flesh is esteemed a delicacy.

These reptiles are characterized by a cutaneous expansion like a pendent dewlap, or flaccid pouch, under the lower jaw and throat, which is capable of being inflated, and there are cuticular folds on the lateral regions of the neck and throat; the head is stout at the base, moderately long, and of a somewhat pyramidal shape; covered with plates forming a sort of tessellated pavement. The scales of the body are small, almost lozenge-shaped, slightly keeled, and but little imbricated. A serrated dorsal crest, consisting of elevated, compressed, and pointed scales, runs along the ridge of the back, and also of the tail to its tip. The tail is of great length, and very flexible: it is laterally compressed. The orifice of the ear is covered by a large tympanic membrane, and generally several large scales are about the angle of the lower jaw. The limbs are long, the toes are unequal, rough with elevated points on the under surface, and armed with acute claws. A range of tuberculous pores runs down the outside of each thigh. Fig. 2154, *a*, *b*, well displays the general characters of the head and limbs of the Iguana, as seen in the Iguana tuberculata.

The teeth vary according to the ages of individuals. They are not lodged in distinct sockets, but are fixed along the internal face of the dental bone in a sort of furrow, and adhere by one side of the bony substance of the root; the exposed part of each tooth is somewhat leaf-shaped, with the edges finely dentelated. Fig. 2155 represents the teeth of the Iguana (lower jaw). Besides these teeth, there is a small row along each side of the vault of the palate.

The iguanas are arboreal in their habits, and feed principally on vegetable aliment, perhaps indeed exclusively, for M. Bibron observes that in the stomachs of the numerous specimens examined by himself he found nothing but leaves and flowers.

Mr. Broderip saw a living iguana about two feet long, in a hothouse at Mr. Miller's nursery gardens near Bristol; it had refused to eat insects and all other kinds of animal food, but on one occasion, happening to come near some kidney-bean plants that were in the house for forcing, it began to eat their leaves, and was from that time regularly supplied with that nourishment. On the contrary, Dr. Buckland, who alludes to this fact, states that in 1828, Captain Belcher found in the island of Isabella swarms of iguanas that appeared to be omnivorous, feeding voraciously on eggs, on the intestines of fowls, and on insects.

These animals haunt the borders of water, into which they often plunge, swimming with great celerity; they place the fore-limbs along each side, throw back the hind-limbs, and vigorously lash the water from side to side with the tail, and dart rapidly forwards.

We have had many opportunities of seeing the guanas in captivity, and have observed that though they become tolerably tame, they still preserve a considerable degree of fierceness; on one occasion we approached a very large specimen, at large in a room, which immediately made several determined snaps at us, though it permitted its owner to lift it up, and carry it about, without demonstrating any signs of anger. The male iguana, during the pairing season, is very savage, and jealously watches over his mate, attacking the intruder with ferocity; his eyes glaring, his dewlap inflated, and his whole appearance indicating the utmost fury.

The female visits the borders of rivers, and savannahs, and also the shore of the sea, in order to deposit her eggs, which she buries in the sand. Both these and the flesh of the animals are in great request, so that in some of the islands where they were once abundant, they have become exceedingly scarce. They are generally taken by means of a noose thrown over their heads, while resting on a branch, from which they are forcibly pulled; and this is the more easy, as they seldom retreat when discovered, but glare on their assailants, inflate their throat, and assume as threatening an aspect as possible. They are also taken in traps and nets, and sometimes are hunted by dogs. They are very tenacious of life, and as they struggle violently, snapping at every person, they are generally dispatched at once by means of a sharp instrument plunged into the brain.

2156.—THE COMMON IGUANA

(*Iguana tuberculata*). Iguana delicatissima, Daudin.

This species is a native of Brazil, Cayenne, the Antilles, and the Bahamas, &c., and attains to a considerable size, measuring in total length sometimes six feet. We have seen many specimens upwards of four, but it must be remembered that the tail surpasses the body. Its flesh is accounted a great luxury, being white and delicate, but it does not agree with some constitutions. In some of the Bahama islands these iguanas or guanas are still common, but much more so formerly, the race having been greatly thinned. Catesby, in his 'Natural History of Carolina' (1743), informs us that it is an article of traffic in the Bahamas, being carried alive from place to place, till required for the tables of the wealthy. These reptiles, he says, "nestle in hollow trees; their eggs have not a hard shell like those of alligators, but a skin only like those of a turtle, and are esteemed good food. They lay a great number of eggs at a time in the earth, which are hatched by the sun's heat. The guanas furnish a great part of the subsistence of the inhabitants of the Bahama islands; for which purpose they visit many of the remote kayes and islands in their sloops, to catch them, which they do by dogs trained up for that purpose, and which are so dexterous as not often to kill them. If they do so, however, the guanas serve only for present use; if otherwise, they sew up their mouths to prevent their biting, and put them into the hold of their sloop, until they have obtained a sufficient number, which they either carry alive for sale to Carolina, or salt and barrel up, for the use of their families at home. These guanas feed wholly on vegetables and fruit, especially on a particular kind of fungus growing at the roots of trees, and on the fruits of the different kinds of Ananas; their flesh is easy of digestion, delicate, and well tasted: they are sometimes roasted, but the more common mode is to boil them, taking out the fat, which is melted and clarified and put into a dish, into which they dip the flesh of the guana as they eat it. Though not amphibious they (the guanas) are said to keep under water above an hour. They cannot run fast, and their holes are a greater security to them than their heels. They are so impatient of cold that they rarely appear out of their holes but when the sun shines."

In Jamaica this lizard is now nearly if not quite extinct; formerly it was tolerably common. Brown, in his history of that island (1756), says that the guana lives for a considerable time without food (as indeed do most reptiles), and changes its colour with the weather, or the natural moisture of its place of residence. "I have kept," he adds, "a grown guana about the house for more than two months; it was very fierce and ill-natured at the beginning, but after some few days it grew more tame, and would at length pass the greatest part of the day upon the bed or couch, but always went out at night. The flesh of this creature is liked by many people, and frequently served up in fricassees at their tables, in which state it is often preferred to the best fowls. When taken young the guana is easily tamed, and is both a harmless and beautiful creature in that state.

The general colour of this species is dark green, more or less tinged with olive, sometimes with blue; generally a few brown bands are observable on the sides; the tail is alternately ringed with brown and greenish, or yellowish green; the sides of the neck are covered with tubercles; a large circular scale is conspicuous on the lower jaw below the tympanic membrane of the auditory orifice.

2157.—THE SMOOTH-NECKED IGUANA

(*Iguana nudicollis*). Iguana delicatissima Laurenti.

This species, which is a native of Brazil, Martinique, Guadaloupe, &c., differs from the preceding in the absence of tubercles on the neck, and of the great circular plate beneath the tympanic membrane; it has a range of large strong scales along each branch of the lower jaw. Its general colour is of a uniform green, or rather bluish green, paler beneath. Its habits and manners are the same as those of the Ig. tuberculata, and its flesh is equally esteemed.

A third species, more nearly allied to the Iguana tuberculata, is a native of Mexico, and also of St. Domingo or Hayti. It is distinguished by having the muzzle surmounted with three or four scales, elevated in the form of compressed horns, and placed in a series. There is a large circular plate below the tympanic membrane.

These three species have been till recently confounded together, and the title "delicatissima" has been applied equally to them.

2158, 2159, 2160.—REMAINS OF IGUANODON.

In the Wealdon fresh-water formation of the South of England, intermediate between the marine oolitic deposits of the Portland stone, and those of the green sand formation in the cretaceous series, the remains of an extinct gigantic reptile occur, closely allied to the Iguana of modern days. We owe the discovery of them to Dr. Mantell. The teeth, which Cuvier at first regarded as those of a rhinoceros, evidently indicate an herbivorous appetite, and were fitted for grinding tough vegetables to a pulp.* The length of this reptile could not have been much under seventy feet, and was perhaps more.

"The teeth," writes Dr. Buckland, "exhibit two kinds of provision to maintain sharp edges along the cutting surface, from their first protrusion, until they were worn down to the very stump. The first of

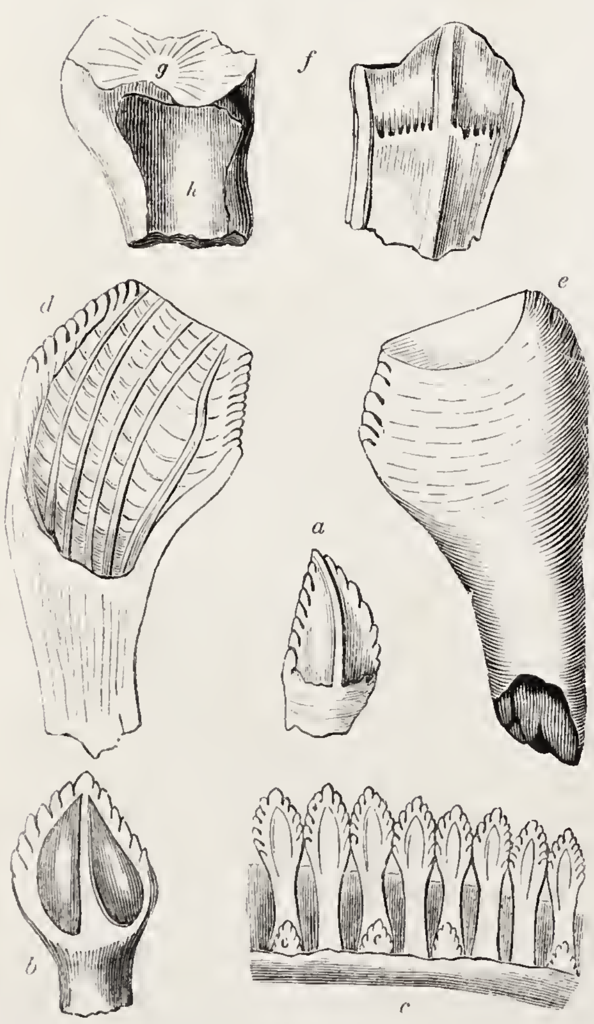
* The fossil remains of Clathraria and similar vegetables were found entombed with the relics of the Iguanodon.

2154.—Head and Limbs of Iguana.

2160.—Nasal Horn of Iguanodon.

2156.—Common Iguana.

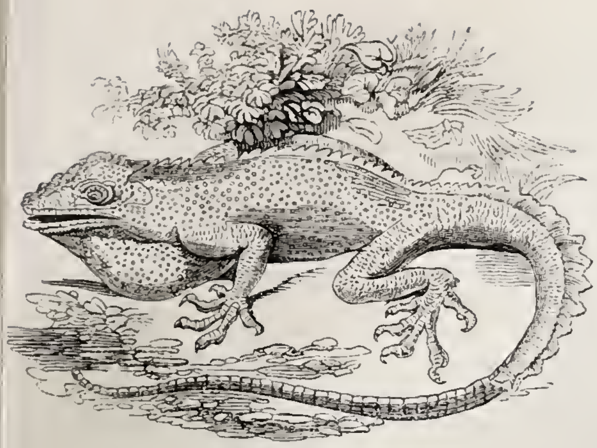
2157.—Smooth-necked Iguana.



2158.—Teeth of Fossil Iguanodon.

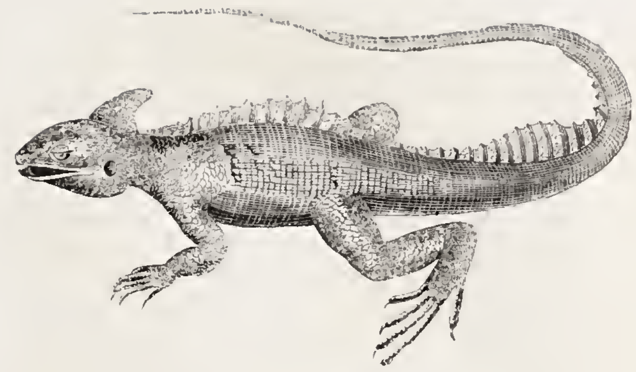
2155.—Lower Jaw of Iguana.

2159.—Teeth of Iguanodon.

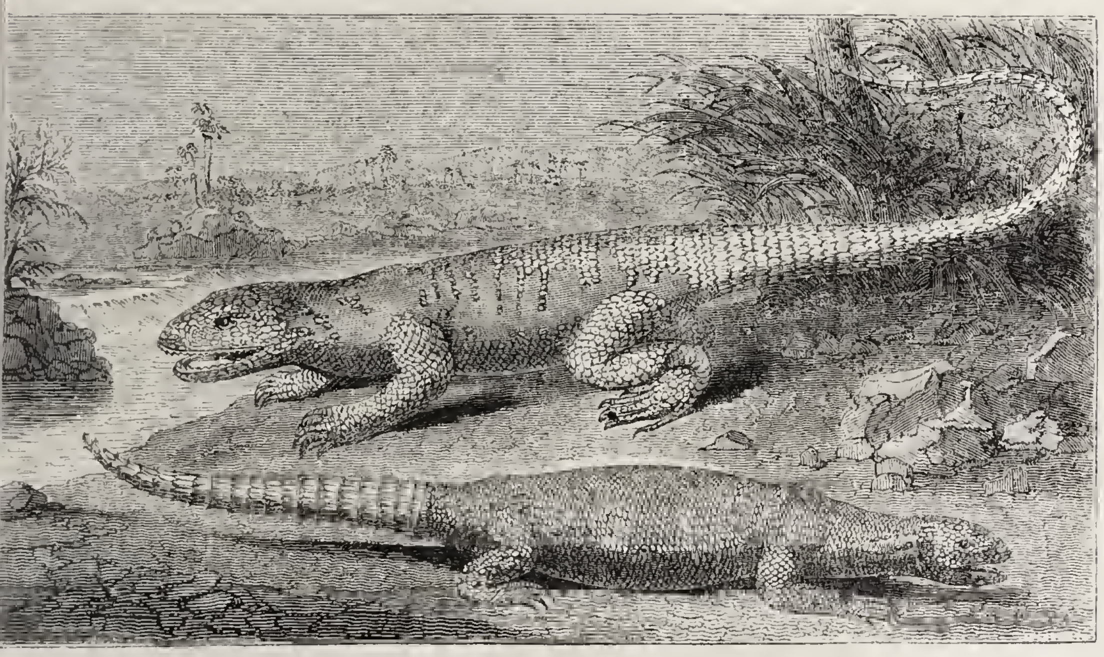


2161.—Great Crested Anolis.

2162.—White-scarfed Anolis.

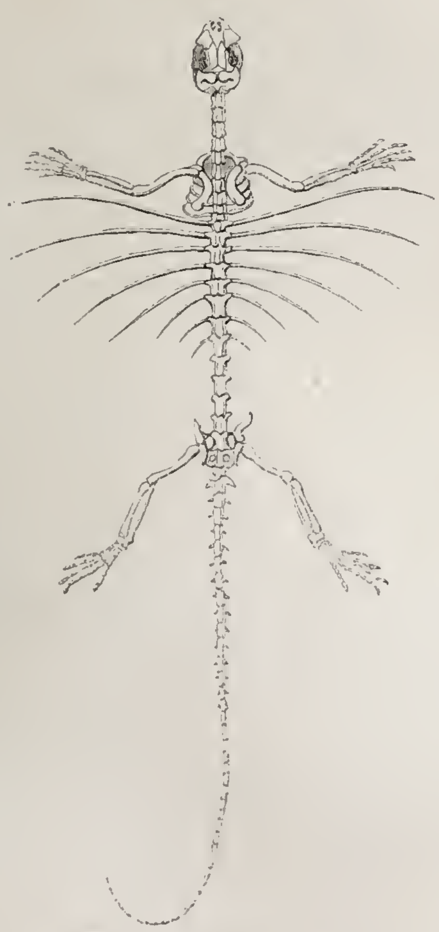


2163.—Hooded Basilisk.



2168.—Common Stellio and Spine-footed Stellio.

2164.—Fringed Dragon.



2165.—Skeleton of Fringed Dragon.

2167.—Spine-footed Stellio.

2166.—Common Stellio.

these is a sharp and serrated edge, extending on each side downwards, from the point to the broadest portion of the body of the tooth. The second provision is one of compensation for the gradual destruction of this serrated edge, by substituting a plate of thin enamel, to maintain a cutting power in the anterior portion of the tooth, until its entire substance was consumed in service. Whilst the crown of the tooth was thus gradually diminishing above, a simultaneous absorption of the root went on below, caused by the pressure of a new tooth rising to replace the old one, until, by this continual consumption at both extremities, the middle portion of the older tooth was reduced to a hollow stump, which fell from the jaw to make room for a more efficient successor." The young tooth somewhat resembled a serrated lancet. Dr. Buckland observes, that this serrature ceased at the broadest diameter of the tooth, that is, precisely at the line below which, had the serrations been continued, they would have had no effect in cutting. As these saw-like edges were gradually worn away, the cutting power was transferred to the enamel in front, which was traversed by alternate longitudinal ridges and furrows, the latter serving "as ribs or buttresses to strengthen and prevent the enamel from scaling off, and forming, together with the furrows, an edge slightly wavy, and disposed in a series of minute gouges, or fluted chisels; hence the tooth became an instrument of greater power to cut tough vegetables under the action of the jaw, than if the enamel had been in a continuous straight line. By these contrivances also, it continued effective during every stage through which it passed, from the serrated lancet point of the new tooth to its final consumption."

At Fig. 2158 are exhibited, *a*, the Crown of a Tooth of the Iguanodon not worn by use, closely resembling *b*, the Magnified Tooth of a recent Iguana, *c*, is a Portion of the Upper Jaw of a recent Iguana with Eight Teeth highly magnified; *d*, Front View of a Tooth of the Iguanodon, natural size, the point is worn by grinding food; *e*, is a Back View of the same Tooth: *f*, Front and Back View of a Tooth of the Iguanodon worn down by use; *g*, the Worn Surface; *h*, the Cavity formed by the pressure of a new tooth, as in the teeth of the Iguana at *c*.

Fig. 2159 exhibits, *a*, the Young Tooth of Iguanodon: *b* and *c*, Teeth further advanced and worn.

Fig. 2160 exhibits a sort of Nasal Horn (one third the natural size) seated on the snout of this huge reptile, the thigh bone of which exceeds in bulk that of the largest elephant, and measures from four to five feet in length. These relics have been collected in the Isle of Wight, and Purbeck, Tilgate Forest, and in the Rag-quarries near Maidstone.

2161.—THE GREAT CRESTED ANOLIS

(*Anolis velifer*). The genus Anolis is peculiar to America and the adjacent islands, where the species appear to take the place in some measure of the geckos, the structure of their toes enabling them, if not to traverse a smooth wall or ceiling, at all events to climb with great facility. The last joint but one of each toe is furnished with a pad beneath, more or less developed, and transversely striated, so as to act as a sucker, and thus secure the animals more firmly to the trunks or branches of trees over which they may be making their way. The toes are long, well divided, and furnished with sharp hooked claws. The limbs are long. The tail is slender, elongated, compressed, and tapering. The skin is irregularly granulated with round scales; those on the head are mostly pentagonal or hexagonal. The tongue is short, fleshy, rounded at the tip, and very restricted in its movements, being attached almost throughout its whole length to the lower jaw. The teeth, of which, besides the maxillary there are two palatal rows, are sharp and serrated. The skin of the throat forms a pendulous dewlap capable of being inflated, and in one species, a native of the West India Islands (A. bullaris, Gmel.), is when distended of a bright cherry red. The nostrils are small, and the tympanic membrane is more or less below the level of the auditory orifice, which is minute and simple. In some species both the back and tail are furnished with a longitudinal notched crest; in some that on the tail is wanting.

Slender, active, and of small size, these little reptiles frequent woods and rocky places, running, climbing, and leaping with singular address and celerity; so rapid indeed are their movements, that they have been compared to the flitting of birds. When tired and overheated by these exertions, they stop, open their mouths, and pant like a dog. They are very timid and harmless, and when under the influence of fear or anger, or otherwise excited, they dilate the dewlap, or loose fold of the throat, to a great extent, and assume an endless succession of ever-varying hues, the tints of the skin generally, but especially of the throat, changing with even greater rapidity than in the chamelion. Though often inhabiting woods and thickets along the borders of rivers, it does not appear that they take to the water like the iguana. Insects constitute their food, and these they pursue with great eagerness and celerity. Cuvier, however, found berries in the stomach of the Great Crested Anolis.

The great crested anolis is one of the largest of the genus, the body measuring a foot in length: it is a native of Jamaica and the Antilles, generally residing in woods and lodging in hollow trees, where the female deposits her eggs. This species is extremely restless, ever in motion; timid, and yet not without curiosity, for while peeping from the bough of a tree, as if to scrutinize what might be going forward, it allows itself to be caught in snares, and will also unsuspiciously noose itself in those which the children in the West Indies place in its haunts, alluring it from its concealment by imitating its voice. When pleased it utters a low but acute chirp.

A dentilated crest, supported by the elongated spinous processes of the vertebral column, runs along the back and half of the tail; the dewlap is very extensive. Its colour is a dark ashy blue.

2162.—THE WHITE-SCARFED ANOLIS

(*Anolis equestris*). Le grand Anolis à écharpe of Cuvier.

This species inhabits the Antilles, and specimens in the Paris Museum have been received from Cuba. It is also found in Jamaica, and is figured by Sir Hans Sloane in his history of that island.

This species equals the preceding in size; there is but an indication of a crest on the base of the tail, which is more fleshy than in anolis velifer, so as to conceal the spinous processes, which are equally as elongated as in that reptile. The general colour is a pale tawny, the yellow clouded with blending tints of ashy lilac. The skin of the throat is white, and a band of the same colour passes over each shoulder and runs half-way down each side.

Mr. Bell, in his interesting work on 'British Reptiles,' relates a singular circumstance respecting the green anolis of the West Indies (Anolis bullaris, Gm.; Anolis Chloro-cyanus, Bibr.), which, as he well remarks, proves that lizards in the act of seizing their food must often be exposed to danger from the noxious qualities of the insects which they indiscriminately attack; and he adds, "the following fact would seem to indicate that, even in our own temperate climate, an insect not generally recognised as poisonous may inflict a fatal injury on its Saurian enemy." "Some years since," he continues, "I had in my possession two living specimens of the beautiful little green anolis of the West Indies, a lizard about the size of our own smallest species. I was in the habit of feeding them with flies and other insects, and having one day placed in the cage with them a very large garden spider, Epeira Diadema, one of the lizards darted at it, but only seized it by the leg. The spider instantly ran round and round the creature's mouth, weaving a very thick web round both jaws, and then gave it a severe bite in the lip, just as this species of spider does with any large insect which it has taken. The lizard was greatly distressed; and I removed the spider, and rubbed off the web, the confinement of which appeared to give it great annoyance; but in a few days it died, though previously in as perfect health as its companion, which lived for a long time afterwards."

2163.—THE HOODED BASILISK

(*Basiliscus mitratus*). Though the Basilisk of the ancients was a fabulous animal, the name is still retained as the title of an American genus of Iguanian reptiles, distinguished by an elevated fin-like crest on the back and basal portion of the tail, supported by the elongated spinous processes of the dorsal and caudal vertebræ: the skin of the throat, contrary to the general rule, in the present reptile is not dilatable; but to counterbalance this, there is a large membranous sac on the occiput, capable of being distended with air at pleasure. The head is thick and short, the general contour stout; the limbs long and powerful; the tail elongated, tapering, and compressed at the sides; the toes long and armed with small claws; the skin is covered with small scales of a rhomboidal form, and generally speaking slightly carinated. Palatal as well as maxillary teeth. No femoral pores.

In their habits these animals, like the iguanas, are arboreal, climbing with great ease and celerity; but they are also aquatic, swimming with great address, while they lash the water from side to side with their finny tail. They are said to live on grain and fruits. The flesh is held in estimation.

The Hooded Basilisk is a native of Guiana, Martinique, and the tropical countries of South America generally, and attains to a considerable size, the tail being nearly twice as long as the head and body. It is very harmless, though of formidable aspect, and when alarmed drops off the branch into the water and swims rapidly away. The colour is yellowish brown passing into white on the under parts; the throat is longitudinally striped with leaden brown, which colour prevails on the sides of the neck; a longitudinal stripe edged with black extends from each eye along the back of the neck to the sides of the dorsal region, and there blends with the general tint. The hood and crests are more developed in the male than the female.

A distinct species, the Banded Basilisk (B. vittatus, Weigmann), inhabits the forests of Mexico. We may now pass to the acrodontous iguanidæ.

2164.—THE FRINGED DRAGON

(*Draco fimbriatus*). The little harmless arboreal reptiles distinguished by the portentous name of Draco, have nothing in them to startle the most timid: they are distinguished at once by a wing-like expansion of skin along their sides, supported by the six first false ribs, which are very slender and greatly elongated (see Skeleton, Fig. 2165), and which when at the full stretch acts the part of a parachute, enabling these creatures to skim, like the flying squirrels, from branch to branch, or from tree to tree, with great ease, but in no respect approximates either in structure or action to the wing of a bird or bat.

Below the throat hangs a long pointed dewlap, supported by a stylet of the os hyoides. On each side of the neck is a fold of skin, and there is generally a small cervical crest; the tongue is thick and rounded. The head is short, and triangular; the limbs long; the thighs without pores. The tail is long and slender. The skin is covered by small imbricated scales, of which those of the limbs and tail are carinated. Several species are known, natives of India, Java, Sumatra, Timor, Manilla, &c.

In their habits these little sweeping lizards are arboreal, searching on the leaves and in the crevices of the bark of trees for insects, on which they feed. They are prompt in their motions.

The Fringed Dragon is a native of Java; the upper parts are clouded with brown on a grey or olive grey ground, and often ornamented with black spots within a white ring; the wings are striped with white. Fig. 2164 exhibits this species (natural size), profile of the head, and one of the toes (enlarged).

2166.—THE COMMON STELLIO

(*Stellio vulgaris*). In the genus Stellio the head is triangular, flattened, and moderately long; the sides of the muzzle angular; the tongue thick, spongy, and slightly notched at the point: on each side of the back is a fold of skin covered with larger scales than those of the sides. No femoral pores, but follicular scales across the lower part of the abdomen. The tail is subconical and covered with rings of scales more or less spinous. The back and thighs are here and there varied with scales exceeding the rest, and sometimes spinous; small groups of spines surround the auditory orifice.

The Common Stellio measures about a foot in length, and is spread over the whole of the Levant: it is extremely common in Egypt, Syria, and Greece, where it tenants old walls, ruins, masses of mouldering piles of stones, retiring within the crevices for safety. It feeds on all kinds of insects. It is called *κοσκορδιλος* by the modern Greeks, and Hardun by the Arabs. It has a curious motion of the head, wherefore the Mahometans make a point of killing it, because they say it mocks them by bending down its head, as they do during their devotions. The general colour of this species is olive clouded with black; all the under parts yellow, or olive yellow.

2167.—THE SPINE-FOOTED STELLIO

(*Uromastix spinipes*). Le Fouette-queue d'Egypte of Cuvier.

The genus Uromastix differs from Stellio in the head being less swollen posteriorly; and all the scales of the body are small, smooth, and uniform; those of the tail are, however, much larger and more spiny than in the common stellio, but are wanting on the under surface. There is a series of femoral pores. The muzzle is arched above.

This species attains to the length of two or three feet, and is a native of Egypt, where it inhabits deserts, tenanting mouldering ruins, and other places of refuge. Belon regarded it as the land crocodile (*κροκοδειλος χερσαιος*) of Herodotus and the ancients, but without any proof; that animal was most probably the Desert Varan of Egypt (Varanus arenarius), the *waral* or *ouaran el hard* of the Arabs.

The present reptile has a row of spinous scales along each thigh; its body is tumid; its general colour, while alive, of a fine grass green, which becomes lost in dried specimens, or such as are preserved in spirits.

2168.—THE COMMON STELLIO AND THE SPINE-FOOTED STELLIO.

These reptiles, which we have just described, were, no doubt, well known to the Latins. Our classical

readers are well acquainted with the term stellio, and that one, if not both, of the reptiles in question is "Le Stellion des Anciens" is the opinion of Isidore, Geoffroy, and naturalists generally.

The upper figure is that of the Common Stellio, the lower that of the Spine-footed Stellio.

2169.—THE MURICATED LIZARD

(*Grammatophora muricata*). Agama muricata, Daudin.

The genus Agama, of Daudin and others, is in the present day greatly subdivided: the group indeed, according to Mr. Gray's arrangement, constitutes a family per se, but not in the system of MM. Dumeril and Bibron.

The agamas are in general short thick-bodied lizards, covered with a lax skin, capable of being inflated with air at the will of the animals, and covered with minute scales, often keeled, or spiny, and some species are defended by a bristling panoply of sharp spikes. Many are very toad-like, and, were it not for the presence of a tail, might be mistaken for that reptile on a first glance. In the restricted genus Agama there are no thigh-pores; in other genera, however, these exist. They usually reside among rocks, heaps of stones, and mouldering ruins, concealing themselves in chinks and fissures, and their dull and sombre colours tend to their eluding notice; such have the limits short, and the toes stout. Others, with a more slender contour, longer limbs, and more flexible toes, are more or less arboreal, and ascend trees with facility. The head is generally short, broad, and flat, and the tail comparatively short. There are no palatal teeth; the tongue is short and spongy. Many are capable of changing the colours of the skin.

The geographical distribution of the agamas is very extensive; they are found in Asia, Africa, America, and Australia.

In the genus Grammatophora the scales of the back are imbricated and carinated, here and there beset with spines; the tail is long and conical, and covered with scales disposed in a tile-like manner; the tympanic membrane is large; femoral pores exist. The general figure is more slender than in most of the other genera, but still depressed, and the form of the upper surface of the head is triangular. The muricated lizard is a native of New Holland, and was first described by the celebrated John Hunter in the zoological part of White's Voyage to New South Wales. In its habits it is arboreal, living in the woods, and traversing the trunks and branches of trees in quest of insects and their larvæ; it is quick and active in its movements, and in some districts is very common.

The length of this species, including the tail, which is twice as long as the body, is twelve or fourteen inches. The toes are long and well divided, and furnished on the under surface with small pointed scales. The general colour is brownish grey marked with dusky bars, running on the body in a longitudinal direction, but transversely on the limbs and tail. The scales covering the upper parts of the trunk, the sides, and the extremities are rhomboidal and carinated, or elevated into sharp pointed ridges forming numerous parallel rows of spines, from the top of the back to the end of the tail. The head is covered with scales similarly carinated, forming upon the occiput a crest of weak spines; of the toes the two middle by far exceed the others.

2170.—THE SPINY AGAMA

(*Agama spinosa*, Bibron). Agama aculeata, Cuvier.

This species has been confounded with another, the Agama aculeata of Seba, a much more slender animal, but a native of the same country, viz., the Cape of Good Hope; both are referable to the Lacerta hispida of Linnæus, 'Syst. Nat.,' 10th edit.

The true agama spinosa is a short squat lizard, covered on the upper surface of the body with scales having sharp elevated points, those of the under parts being also carinated and sharp. The general colour above varies from yellow to olive brown, varied with markings of black. It is common in South Africa.

We may here observe that the genus Agama of Dumeril and Bibron includes Trapelus of Cuvier, and consequently that singular species the Orbicular or Changeable Agama of Egypt (A. mutabilis, Merrem.; Trapelus Ægyptius, Cuvier), and two allied species, besides several others.

2171.—THE CHANGEABLE AGAMA

(*Agama mutabilis*, Merrem). Trapelus Ægyptius, Cuvier; Trapelus mutabilis, Gray; l'Agame variable ou changeant, Isidore and Geoffroy; Rept. d Egypte, l'Agame orbiculaire, Daudin.

This species is very common in Egypt, Persia, and the North of Africa; it is also found in Nubia. "It is on this species," says M. Bibron, "that Cuvier has founded the genus Trapelus, which cannot be preserved, because it has no character really of importance to distinguish it from Agama; not even that on which Cuvier rested (viz., the smoothness of the scales); for the scales of the back, though they present less developed spines than those of most of the agamas, are not destitute of them, as the author of the 'Règne Animal' has stated." This little lizard has obtained the title "orbicular" from its habit of inflating its body, and assuming a puffed up, toad-like appearance; and that of "changeable" from its frequent change of colouring. It is, as M. Geoffroy observed, often of a deep blue clouded with violet, having the tail ringed with black, and with four or five regular transverse lines of reddish spots on the back. At other times the blue is exchanged for pale lilac, while the head and feet are tinged with green, the little reddish spots of the back alone remaining. We have seen some of a pale olive, with the throat blue and the under parts of a green tint, some of a uniform ashy grey, others clouded or spotted with brown.

2172.—THE FRILLED LIZARD

(*Chlamydosaurus Kingii*). This extraordinary lizard, a native of Australia, is at once to be known by an expanse of skin supported by a crescent-shaped cartilage, on each side of the neck forming an expanded frill, capable of being folded up or spread out; the edge of this frill is serrated, and the whole is covered with small keeled scales; the head is short; the tail long; the feet well adapted for climbing. There are femoral pores.

When fully grown this species measures nearly three feet in total length; it is arboreal in its habits, and was first discovered by Mr. Allan Cunningham, who accompanied Captain King's Expedition as botanical collector. He found the specimen, from which the original description was taken, on the branch of a tree in Careening Bay, at the bottom of Port Nelson, and sent it to Sir E. Home, by whom it was deposited in the museum of the Royal College of Surgeons. In his Journal Mr. Cunningham thus writes:—"I secured a lizard of extraordinary appearance, which had perched itself upon the stem of a small decayed tree; it had a curious crenated membrane, with a ruff or tippet round its neck, covering its shoulders, and when expanded by means of slender transverse cartilages it spreads five inches on each side in the form of an open umbrella. Its head was rather large, and its eyes, whilst living, rather prominent; its tongue, though bifid, was thick and short, and appeared to be tubular."

Several fine specimens of this lizard are in the British Museum.

Captain Grey (see his 'Travels in Australia,' vol. i. p. 194) says, "As we were pursuing our route in the afternoon we fell in with a specimen of the remarkable frilled lizard (Chlamydosaurus Kingii). It lives principally in trees, though it can run very swiftly along the ground. When not provoked or disturbed it moves quietly about with its frill lying back in plaits upon the body, but it is very irascible, and directly it is frightened it elevates the frill or ruff and makes for a tree, where, if overtaken, it throws itself upon its stern, raising its head and chest as high as it can upon the fore-legs, then doubling its tail underneath the body, and displaying a very formidable set of teeth from the concavity of its large frill, it boldly faces an opponent, biting fiercely whatever is presented to it, and even venturing so far in its rage as to fairly make a charge at its enemy. We repeatedly tried the courage of this lizard, and it certainly fought bravely whenever attacked. From the animal making so much use of its frill as a covering and means of defence for its body, this is most probably one of the uses to which nature intended the appendage should be applied."

The general colour of this species is yellowish brown, variegated with black; tongue and inside of the mouth yellow.

Family VARANIDÆ (VARANS).

With the exception of the Crocodiles, the Varans are the largest of the Saurian reptiles; their figure is elongated and graceful, their actions quick and alert; some are terrestrial, but others with the tail compressed laterally are aquatic, swimming with the greatest celerity.

In the terrestrial varans the tail is conical, and nearly rounded, and on land assists the animals in their rapid serpentine movements, and in springing upon their prey; the head is elongated; the muzzle acute; the eyes large and bright; the auditory orifices are very apparent, and seated near the angle of the mouth; the tongue is fleshy and very extensible, being, when fully protruded, nearly twice as long as the head: it is deeply forked at the tip like that of a snake. There are no palatal teeth nor femoral pores.

The skin is covered with scales, not imbricated, but placed side by side so as to form circular rings; they are of an oval form, convex, and surrounded each by an annular row of small tubercles. There is a fold between the neck and chest. The limbs are powerful, the toes large and strong, and armed with sharp claws.

The usual places tenanted by the terrestrial varans are deserts and rocky places; the aquatic species frequent the banks of rivers: in the latter the tail is a most important instrument of progression in the water; they lash it with great energy from side to side, thus propelling themselves along with vast rapidity.

The food of these reptiles consists of the larger kinds of insects, as locusts, &c., various kinds of lizards, eggs, birds, and small mammalia, tortoises, fishes, &c. M. Duméril, on the authority of M. Leschenault de Latour, confirms the accounts of travellers, who assert that they often combine in order to chase their prey; he assures us that they unite in packs on the borders of rivers, and seize such quadrupeds as approach unsuspectingly to drink. He has seen them pursue a young deer which was attempting to swim across a river, and succeed in drowning it. He found on one occasion the thigh bone of a sheep in the stomach of a specimen which he dissected.

Of these animals none are European, and one only (Heloderma horridum) a native of America; the others are natives of India and its islands, the Philippines, the Moluccas, &c., and also of Australia.

Fig. 2173 exhibits—*a*, the Head of Varanus nebulosus; *b*, the Dorsal Scales of the same; *c*, the Dorsal Scales of Varanus Niloticus; *d*, the Dorsal Scales of Varanus Piequotii.

One species, the desert varan of Egypt, the Ouaran-el-hard of the Arabs (Varenarius), is most probably the terrestrial crocodile of Herodotus, which he describes as a species not more than three cubits in length, and much like a lizard.

Under the title Monitor, Cuvier comprehends the Varans, and the Teguixins and Ameivas of America (Teidæ of Mr. Gray). It is best to drop the term Monitor altogether.

2174.—THE WHITE-THROATED VARAN

(*Varanus albogularis*). Tupinambis gularis, Daudin; Varanus ornatus, Merrem; Tupinambis albogularis, Kuhl; Polydædalus albogularis, Wagler; Monitor albogularis, Gray.

This varan is a native of South Africa, and though not strictly aquatic in its habits, often resorts to water in quest of prey.

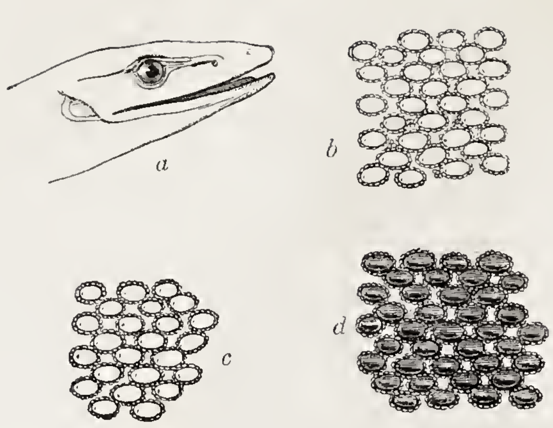
We learn from Dr. Smith that during his expedition, he did not obtain any specimens south of Latakoo; but he says there is reason to believe that it occasionally occurs within the limits of the Cape Colony; and adds that it is in all probability the animal called *das adder* by the colonists, and which is so much dreaded from a supposition that it is extremely venomous. "It is usually discovered in rocky precipices, or on low stony hills, and when surprised seeks concealment in the chinks of the former, or in the irregular cavities of the latter; and when any irregularities exist on the surface of the stones or rocks, it clasps them so firmly with its toes, that it becomes a task of no small difficulty to dislodge it, even though it be easily reached. Under such circumstances the strength of no one man is able to withdraw a full-grown individual, and I have seen two persons required to pull a specimen out of a position it had attained, even with the assistance of a rope fixed in front of its hinder legs. The moment it was dislodged it flew with fury at its enemies, who by flight only saved themselves from being bitten. After it was killed it was discovered that the points of all the nails had been previously broken, or at the moment it lost its hold. It feeds upon crabs, frogs, and small quadrupeds, and from its partiality to the two former, it is often found among rocks, near running streams, which fact having been observed by the natives, has led them to regard it as sacred, and not to be injured without danger of drought." This species, when adult, measures nearly five feet in length. Its colours are mingled brown and yellow, with spots of black.

2175.—THE VARAN OF THE NILE

(*Varanus Niloticus*). This species, one of the aquatic tribe, is very common in the Nile, in the Senegal, and the Galbar near Sierra Leone. It would appear also to inhabit the rivers of Southern Africa, if the species seen there by Sparrman and Le Vaillant are the same.

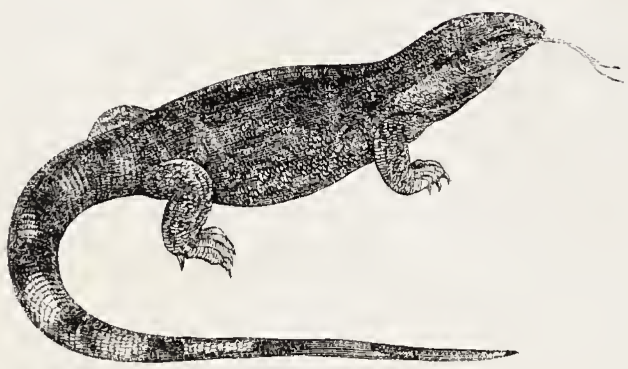
The present animal is often seen sculptured on the monuments of the ancient Egyptians, though it does not appear to be noticed by Herodotus, who perhaps confounded this and the land varan together. The inhabitants of Egypt assured Geoffroy St. Hilaire that this *ouaran* was the first state of the young crocodile, an assertion the more surprising as they could not have been ignorant of the characters

2169.—Muricated Lizard.



2173.—Head and' Dorsal Scales of Varans.

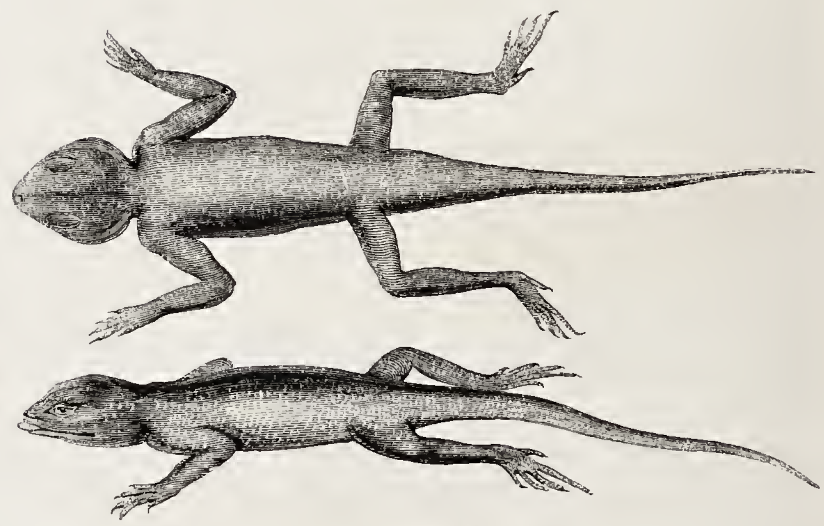
2170.—Spiny Agama.



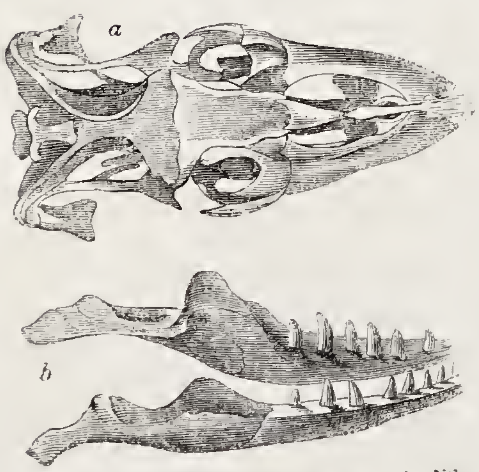
2174.—White-throated Varan.

2175.—Varan of the Nile.

2177.—Bell's Varan.



2171.—Changeable Agama.

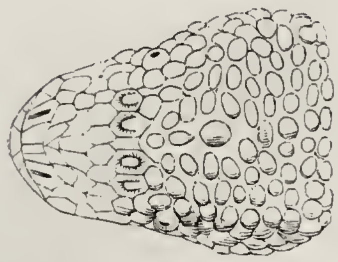


2176.—Skull and Under Jaw of Varan of the Nile.

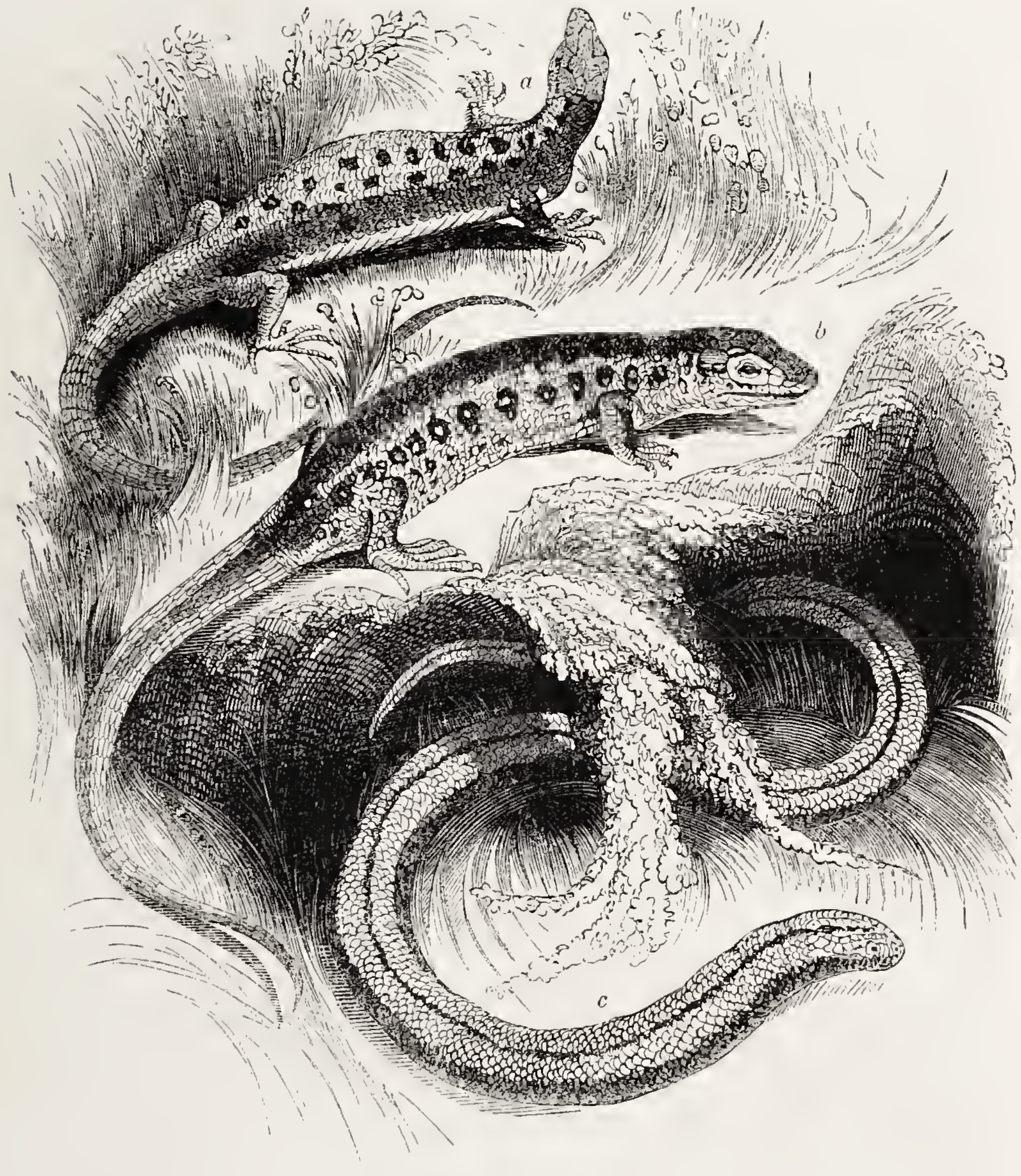
2172.—Frilled Lizard.

2178.—Rough-scaled Heloderma.

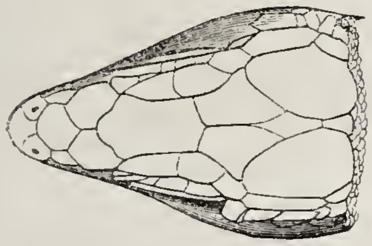
2181.—Teguixin.



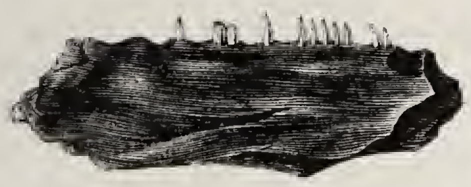
2179.—Scales of Head of the above.



2185.—Group of Lizards.



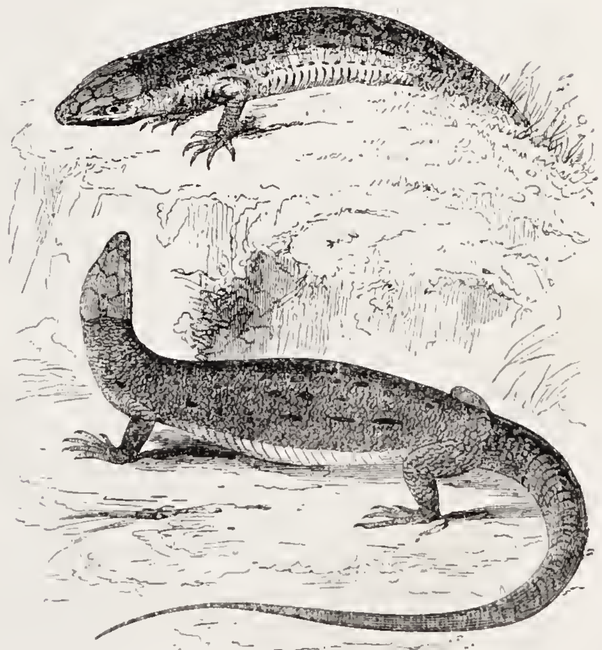
2182.—Head of a True Lizard.



2186.—Lower Jaw of Lizard: Fossil.

2184.—Sand-Lizard

2180.—Head of Teguixin.



2183.—Viviparous Lizards.

of that animal, both young and adult. It swims admirably, and causes great destruction among the young crocodiles, which can only escape by taking refuge under the adults of their own species. It also searches for the eggs of that reptile, devouring them like the ichneumon.

The length of the Varan of the Nile is between five and six feet; its general colour is greenish grey mottled with black; four or five horseshoe marks of yellow in succession are on the back of the neck, and seven or eight rows of spots, of a greenish yellow tint, extend from the shoulders to the root of the tail; a black stripe runs before each shoulder. The first half of the tail is banded with black, the remainder ringed with greenish yellow. Fig. 2176 exhibits—*a*, the Skull of this species seen from above; *b*, the Under Jaw.

2177.—BELL'S VARAN

(*Varanus Bellii*). This beautiful varan is a native of New Holland, and one of the aquatic tribe: it is agreeably parti-coloured; deep black and pale yellow or whitish. It is a large species, and agrees in habits with the rest of its race.

2178.—THE ROUGH-SCALED HELODERMA

(*Heloderma horridum*). In the genus Heloderma the scales are not encircled by a ring of granules; the tail is rounded; and the fifth toe of the hind-foot is on the same line at its origin as the rest. The disposition of the scales of the head is exhibited at Fig. 2179.

One species only is known, a native of Mexico, where there is a general but erroneous belief that its bite is fatal. The general colour of this species is of a blackish brown above, paler below; there are red marks on the neck and back, dotted with yellowish or whitish; the tail is ringed with reddish. Length about three feet.

Family TEIDÆ (TEGUIXINS).

This family is exclusively American, and contains those large lizards known as safeguards, monitors, &c., from an idea that they gave warning by a hiss of the proximity of the alligator, and the same has been supposed, but erroneously, respecting the varans.

The tongue in these Teidæ is long, extensible, forked, and with a basal sheath, into which it is retracted. No palatal teeth. Tympanic membrane on a level with the skin. Back covered with small angular, smooth, but not imbricated scales, disposed in transverse bands. Ventral plates flat, smooth, and oblong.

Skin of the lower part of the neck disposed in two or three simple transverse folds. Head covered with large plates. Femoral pores present. Tail long, and slightly compressed. Fig. 2180 displays Head of the Teguixin or "Sauvegarde."

These lizards are natives of the warmer portions of America, inhabiting fields, thickets, and the borders of woods, as well as sandy arid plains, and sterile spots, where they are said to form deep burrows, in which they hybernate. According to MM. Duméril and Bibron, they are not arboreal, never ascending trees. Azara states that when pursued, should they meet with a lake, pond, or river, they throw themselves into the water, in order to escape the danger which threatens them, and do not emerge till all cause for fear is over. These animals however, as MM. Dumeril and Bibron observe, have not the toes webbed, but their long tail, slightly as it is compressed, becomes without doubt, under such circumstances, a sort of oar, of which they readily avail themselves. It is said by Azara that these lizards feed on fruits and insects, and that they also eat snakes, toads, young chickens, and eggs. He moreover relates that they are partial to honey, and that in order to procure it without being injured by the bees, they have recourse to artifice, advancing at intervals to the hive, which they strike with their tail, and rapidly dart away, till at last, wearied out by repetitions of the annoyance, the industrious inhabitants quit the hive. We cannot help confessing that we have some feelings of doubt as to the correctness of this account.

M. Bibron observes that he has never been able to satisfy himself as to the frugivorous habits of the sauvegardes, but that they feed on insects is fully proved from the stomachs of those opened being found to contain their remains; and on one occasion, amidst the débris of coleoptera, and the shrivelled relics of caterpillars, were found strips of the skin and portions of the bones of a well-known species of lizard, the common ameiva.

The sauvegardes often exceed four feet in length; and are strong and active, and have an imposing aspect.

2181.—THE TEGUIXIN

(*Teguixin monitor*, Gray). Variegated Lizard, Shaw; Great American Safeguard, Griffiths, Cuvier; Lacerta Teguixin, Linn.; Tupinambis monitor, Daudin; Teius monitor, Merrem.; Podinema Teguixin, Wagler; Salvator Merianæ, Duméril and Bibron.

This species is spread over the warmer parts of South America and the Antilles, and was faithfully figured by Madame Merian, both in its young and adult condition; and also by Seba and Spix, and more recently by Prince Maximilien de Wied.

When fully grown it measures nearly five feet in length, and is active and vigorous. Azara says that when, in order to escape danger, it plunges into the water it does not swim, but walks along the bottom; we rather suspect, however, that it dives and remains motionless at the bottom, or under the cover of aquatic plants, being enabled, from the structure of its voluminous lungs, to endure for a considerable time without the necessity of respiration. It defends itself when captured with great resolution, and will bite severely, retaining its hold with inflexible obstinacy, and the same observation applies to it when it has seized its prey. Its flesh is accounted excellent, and Azara says that rings of skin stripped from its tail are worn as preventives against paralysis, from a belief in their efficacy, and that it is considered useful in removing tumours.

The colouring of this species is somewhat variable; generally, however, the ground-colour of the upper parts is black, often deep black, on which sometimes small and irregular spots of a rich yellow, sometimes large regular spots, are disposed so as to produce transverse bands. Generally a stripe runs on each side from the occiput to the root of the tail. Under parts yellow marked with black bands.

Family LACERTIDÆ (TRUE LIZARDS).

Bright-eyed, active, and of slender figure, often adorned with brilliant colours, the true lizards have nothing repulsive in their aspect or manners.

These reptiles are covered above by small imbricated scales; a minute plate of bone protects the orbits above the eyes; the top of the head and the temples are covered with plates or scuta; the scales of the tail are long and narrow, and disposed in rings around it; the tongue is long and forked, the under parts are covered with plates; and a distinct collar of scales, larger than those of the throat, passes across the lower part of the same, anterior to the base of the fore-limbs. A row of pores run down the inside of each thigh. There are generally small teeth on the palate.

Fig. 2182 represents the Head of a True Lizard, as an example of the arrangement of the plates.

2183.—THE VIVIPAROUS LIZARD

(*Zootoca vivipara*). Lacerta agilis of various authors; Nimble Lizard; Common Lizard.

In the genus Zootoca there are no palatal teeth, and the females produce their young alive.

Thickets, heaths, sunny banks, and sheltered orchards are the favourite localities of this little lizard, which in all its actions is graceful, prompt, and rapid. In certain spots they seem to abound. We have often while walking, in the heat of a summer's day, along a sunny bank, covered with furze, counted more than a dozen, within the space of a few yards, basking in the rays, and probably watching for their insect food. We have caught them, by cautiously surprising and rapidly seizing them, but several, notwithstanding all our address, have we missed, and one has occasionally left its tail wriggling in our hand, though we used not the slightest violence, nor ever attempted to retain our hold; it snapped, in fact, like glass, at the slightest touch. It is astonishing to see how rapidly, when alarmed, these agile little creatures gain their burrows, or disappear from view, diving beneath the intertangled vegetation; they seem gone in the twinkling of an eye. Not less prompt and rapid are they in catching their prey; the moment an insect comes near them, or settles on a leaf within due distance, their bright eyes mark it, the next instant it is seized and swallowed: the act is wonderfully quick and instantaneous. The sight of these animals is indeed very acute; and their hearing appears also to be by no means deficient; we have seen them on the slightest noise, on the snapping of a branch, or a rustle made among the leaves, dart off to their burrows, and after a little time cautiously make their re-appearance, and on the least alarm again seek refuge in their retreats.

Unlike most lizards, which produce eggs covered by membrane, and which they deposit in the sand or in other places, to be hatched by the warmth of the sun, the present species brings forth living young, the eggs being hatched while yet within the body of the parent. This species is therefore ovo-viviparous. The membrane covering the eggs is very thin, and the female in the month of June passes a great portion of the day basking in the sun, for the sake of the vivifying heat, as necessary for the exclusion of the young from the eggs as if they had been previously deposited in the sand. It is very remarkable that one out of our two true lizards should be thus ovoviviparous, and one out of our two true snakes, viz. the viper, which brings forth living young, and basks in the sun that the same object may be accomplished.

The number of young which the viviparous lizard produces is four or five, and they are occasionally seen in company with their parent, but whether they are united together by any instinctive attachment is doubtful; the probability is that they keep about the spot where they were born, and where the parent has her burrow, and remove by degrees as they increase in size and strength, for from their birth they are capable of running about, and soon begin to exercise their powers in the capture of prey.

During the winter this, as well as the other British lizard, hybernates, but whether its torpidity is very profound is not ascertained; it appears early in the spring, and continues active till autumn has far advanced, when it betakes itself to its burrow.

This species, and also the sand-lizard, are found in Ireland; with respect to the former, Mr. Bell remarks that on the Continent its range does not appear to be extensive: "It is not," he adds, "found in Italy, nor, I believe, in France, and is very probably confined in a great measure to our own latitude." M. Bibron, however, assures us that it exists both in France and Italy, and that it inhabits Germany, Switzerland, and Russia, as well as the British Islands, preferring mountain districts; and he adds, "M. Tschudi informs us that in Switzerland it frequents, in preference, the forests of dry pines, making its runs under the fallen leaves, and to these it retreats on the appearance of danger. Sometimes, however, it is met with in damp and humid forests. In France it is not so common as the sand-lizard, while in England it is the contrary."

The average length of the viviparous lizard is six inches; its colour and markings are subject to variation; in general the upper parts are of an olive brown, with a dark brown and often interrupted line down the middle of the back, and a broad longitudinal band down each side, between which and the middle line are black dashes or spots. In the male the under parts are of a fine orange spotted with black; in the female pale olive grey.

2184.—THE SAND-LIZARD

(*Lacerta agilis*, Linn.). Lacerta Stirpium, Daudin.

This species, an example of the restricted genus Lacerta, is much larger than the viviparous lizard, sometimes measuring a foot in length; we have seen specimens upwards of seven inches long, and in the 'Linnæan Transactions' an instance is adduced by the Rev. R. Sheppard, in which the measurement exceeded twelve inches (vol. xvi., 1802).

It is to the labours of several modern naturalists that we owe the extrication of this lizard from much confusion, for the term agilis, applied by Linnæus to the present species, has been given in England to the viviparous lizard, and in France and Italy to the wall-lizard, the common lizard of those countries.

The sand-lizard is subject to much variation of colour; indeed, two varieties appear to exist: one, and that the most common, of a sandy brown colour, more or less rich, with obscure longitudinal stripes of a darker tint, and a lateral series of black ocellated spots, each with a white or yellowish dot in the centre; the other variety has the upper parts of a brownish green, the green being more or less decided, with the same general markings.

The ordinary residence of this species is sandy heaths, and though less rapid in its actions than the viviparous, is quick and active, and runs with considerable alertness; occasionally it may be seen basking on sunny banks and in verdant spots, and has been observed also near marshes. According to Mr. Bell, it occurs in the neighbourhood of Poole both on sandy heaths and in moist situations, and that able naturalist adds, "It has been stated, by a gentleman of my acquaintance, that the brown varieties are confined to the sandy heaths, the colours of which are closely imitated by the surface of the body, and that the green variety frequents the more verdant localities. Be this as it may, and it is a statement which at present I can neither confirm nor dispute, it is certain that these varieties mentioned by Linnæus, and seen by Müller, do exist in the place I have named, and within a comparatively short distance." The sand-lizard is common in France, but rare in Italy; it is abundant in the middle districts of Europe, and extends as far north as Sweden and Denmark. It is found in Ireland. According to M. Bibron, it inhabits the plains and hills, but never the mountains, of the Continent, and gives preference to the margin of woods, copses, large gardens, and vineyards. Its retreat is a burrow varying in depth, worked out under a matted collection of herbage, or between

the roots of a tree; in this burrow it hybernates, having closed the entrance with earth and dried leaves; and does not reappear till the warm weather has returned. It feeds on insects. On a transient glance of this species running along, it might be easily mistaken for the viper, as Mr. Sheppard says it was by himself, its length and the arrangement of the colours favouring the deception; its movements indeed are serpentine; if seized whilst thus endeavouring to escape, it will turn and bite, and when captured is impatient of confinement, avoids observation, and ultimately dies. It is indeed extremely timid, and, unlike the beautiful green lizard (Lacerta viridis) of Southern Europe, never can be rendered familiar.

The sand-lizard deposits its eggs, to the number of fourteen or fifteen, in hollows in the sand, which it excavates for their reception, and then carefully covers them up, leaving them to be hatched by the rays of the sun. The young on exclusion from the egg are active, and lead at once an independent existence.

Fig. 2185 exhibit—*a*, the Viviparous Lizard; *b*, the Sand Lizard; *c*, the Blindworm (Anguis fragilis), of which we shall speak hereafter. Fig. 2186 exhibits the fragment of the lower jaw of a lacertine reptile, from the lower chalk near Cambridge.

We have alluded to the beautiful green lizard, which is often brought over to England by Italians for show or sale, and kept in cages. This species is a native of France, Italy, Spain, Greece, and the Mediterranean borders of Africa. It is said also to occur in the island of Guernsey, but it exists neither in England nor Ireland. Orchards, large gardens, shrubberies, brakes and thickets, are the haunts of this lizard, and though it cannot be called arboreal, it climbs the stems of bushes with great facilty in quest of insect food. It is quick and active in its movements, and darts rapidly on its prey. In captivity it soon becomes very tame, and will take flies from those with whom it is familiar, and permit itself to be handled without attempting to bite. It is usually kept in a cage, having an inner compartment filled with moss or dried bran, in which it buries itself, and will remain in a state of hybernation during the winter. This lizard should be protected from sudden changes of weather, for it is very sensitive, and does not well endure cold; it delights to bask in the genial rays of the sun, while its burnished skin glitters with metallic brilliancy. From its beauty and utility in the destruction of insects, it might be kept with advantage in vineries or greenhouses. The general colour of this elegant little species is a rich metallic green, fading into a paler or yellowish tint on the under parts; the back and head are sometimes minutely freckled with black, occasionally with yellow, and a blue tinge not unfrequently pervades the head.

A larger species, attaining to sixteen inches or more in length, also remarkable for the beauty of its colouring, is a native of the southern provinces of Europe and the North of Africa. It is the Eyed Lizard (Lacerta ocellata), so called from being ornamented with round spots of gold and blue, and with rings and irregular markings of black on a bright green ground. In its actions it is extremely prompt and rapid, and as it darts along its colours glisten with metallic lustre in the sun. When driven to act upon the defensive, it manifests great spirit, attacking its assailant with determined resolution; and when it fastens on the muzzle of a dog, it will suffer itself to be killed before it will let go its hold. It makes deep burrows at the roots of trees, under hedges, and in vineyards sloping to the sun, always preferring a south or south-east aspect. Frequently it excavates a deep retreat in layers of sand or other material easily worked, separating two beds of hard calcareous rock.

Like all the true lizards, this species is quick-eyed and wary, and disappears within its burrow with wonderful celerity.

2187.—The Six-Lined Tachydromus

(*Tachydromus sex-lineatus*, Daudin). The genus Tachydromus, which contains only two species as yet known, is distinguished by the peculiar form of the papillæ of the tongue, which resemble folds having the figure of chevrons enclosed one within the other with the summit directed forwards; the head is pyramidally quadrangular, the figure slender, and the tail of extraordinary length, far exceeding in proportion that of any other true lizard. The tongue is not sheathed at the base; it is moderately extensible, and divided at the tip into two flattened filaments. The throat collar is squamous, denticulated, and not very definite. The under parts are covered with imbricated scales, smooth or keeled.

The present species is a native of China, Cochin China, and Java: it is rapid, active, and serpentine in its movements, with the general habits of the lacertine group. The general colour above is olive, and on each side of the back, from the angle of the occiput to the base of the tail, runs a beautiful white stripe between two lines of black; those parts of the sides of the neck and body which are granulated, are prettily sprinkled with small black dots, each with a white centre; the other regions of the sides of the neck and trunk are of a bluish tint with golden reflexions. A line of black runs between the nostril and the eye, and two others of the same colour, separated by a white stripe, extend longitudinally on the temple. The under parts altogether of the head and body are of a pure mother-of-pearl white. The tail is sometimes simply olive; sometimes it presents the colour of burnished copper, or of gold with a brilliant lustre. Length about a foot, of which the tail measures three-fourths. (See Duméril and Bibron, 'Hist. Nat. des Rept.')

2188.—The Ophiops

(*Ophiops elegans*). The principal character of the genus Ophiops, of which we know at present only one species, consists in the absence of eyelids. The tongue is arrow-headed in shape, moderately long, notched at the end, and covered with imbricated squamiform papillæ. There is no scaly collar under the neck; the ventral lamellæ are quadrilateral; there are femoral pores; the toes are carinated below. Fig. 2189 represents—*a*, the Head of Ophiops in profile; *b*, as seen from above, showing the arrangement of the plates; *c*, the throat and lower jaw; *d*, the lower part of the under surface, showing the form of the ventral scales, and the line of pores along each thigh; *e*, the under surface of one of the posterior toes.

The Ophiops is a beautiful active little lizard, of slender figure, found in south-eastern Europe, and the adjacent parts of Asia. Specimens have been brought from Smyrna, and others from the environs of Bakou. Its general colour above is olive or bronze, and two pale yellow lines run along each side of the trunk, separated by two series of black spots, which in young individuals are small and distinct, but blend more together in adults. All the under parts are white.

Family CHALCIDÆ (CHALCIS, SAUROPHIS, SCHELTOPUSIC, &c.).

The Chalcidæ, or "Cyclosaures" of Duméril and Bibron, comprise a series of forms presenting us with a gradual approximation, in external characters at least, to the serpents. Some of them indeed, as Pseudopus and Ophisaurus, Cuvier places in his first section of the Ophidia, or Snakes; and the Amphisbæna at the commencement of the "Vrais Serpents." Following the arrangement of MM. Duméril and Bibron, now generally adopted, at least as far as the principles go, we shall give the characters, as detailed by them, by which the family of the Chalcidæ are distinguished. The body is usually cylindrical, extremely elongated or snake-like, sometimes destitute of limbs, and mostly with the limbs only little developed: there is in general no distinct neck between the head and trunk, which latter imperceptibly merges into the tail. The skin exhibits traces of rings or of verticellations, and in most there is a fold of skin between the belly and sides; the head is covered with scutcheons or polygonal plates; the teeth are not implanted into the maxillary bones, but affixed to their internal margin; the tongue is free, but slightly extensile, broad, and covered with filiform or with scale-like papillæ; it is notched at the point, and not retracted within a sheath.

The group thus characterized is divided into *Ptychopleura*, which, besides being scaled, are distinguished by a lateral fold of skin, and into *Glyptoderma*,* with the skin apparently naked, divided into square or card-like divisions in regular order, and marked with circles at regular intervals; the skin of each card-like division is of a peculiar firm texture, as if tubercular. The eyes, moreover, are destitute of eyelids.

Among the Ptychopleura one genus only is entirely destitute of limbs, namely, Ophisaurus, which would be a serpent were it not that there are true eyelids and an auditory orifice, while the jaws are consolidated, and the tongue not sheathed.

In the genus Pseudopus there are only the rudiments of the hind-limbs. In Gerrhosaus, Trilobonotus, &c., the limbs are well developed, and there are femoral pores. These are lacertine in their aspect.

To the Glyptoderma belong the Chirotes, a snake-like reptile with only anterior limbs, a native of Mexico, the Amphisbænas, and the allied genus Lepidosternon, and Trogonophes, in which the teeth, as an exception, are implanted in the trenchant ridge of these. These are all destitute of limbs.

We shall first attend to our examples of the Ptychopleura.

* Glyptoderma, from γλυπτος, sculptured, and δερμα, skin; Ptychopleura, from πτυξ, πτυχος, a fold, and πλευρα, the side.

2190, 2191.—The Four-toed Snake-Lizard

(*Saurophis tetradactylus*). In this snake-like lizard there are four minute limbs, which are furnished each with four toes; there are femoral pores; the head is covered above with plates; the scales of the upper surface are striated, with a small keel in the middle of each; there are six longitudinal series of ventral lamellæ; a fold runs along each side.

This singular reptile is a native of the southern districts of Africa; its movements, as might be inferred from its figure, are completely serpent-like, but of its habits little is known.

The top of the head is yellow, sprinkled with brown; all the scales of the upper parts are yellow, with a posterior margin of brown; the sides of the mouth are white; two black square spots are below the eye, and two before the ear. Under parts whitish. With the two figures are shown enlarged views of the head and limbs.

2192.—The Anguine Lizard

(*Chamæsaura anguina*). In the present genus the limbs are still more reduced, and are mere stylets, terminating in a single toe. The body is covered with rhomboidal, carinated, and imbricated scales, producing a coarse rasp-like surface. The head is covered above with plates. This reptile is a native of Southern Africa, and has been brought from the Cape of Good Hope. The general colour above is brown, with a narrow streak of yellow down the middle line, spreading over the sides, where it becomes paler, and also over the under surface of the body.

2193.—The Scheltopusic

(*Pseudopus Pallasii*). The transition from the previous reptiles, with limbs imperfect and scarcely developed, to the present genus, in which there are no fore-limbs, and the hind-limbs are mere minute scaly appendages, is very easy. We have here a completely snake-like body, which is serpentine in all its movements; there are indeed the rudiments of pelvic bones, as seen at Fig. 2194; *a a*, showing the rudiments of the hinder extremities.

In this genus the tongue is thin and like an arrow-head, bifid at the point, and covered both with villous, and also with large notched papillæ. The teeth are strong, and the palate is furnished with them also, but they are there of small size. A deep furrow runs down each side of the body. The eyelids are perfect.

The Scheltopusic, which was first described by Pallas under the title of Lacerta apoda, measures about eighteen inches in length, and is of a reddish chestnut colour dotted with black. The iris is golden green, the pupil black. The young are greyish above with cross-marks of brown, whitish grey below.

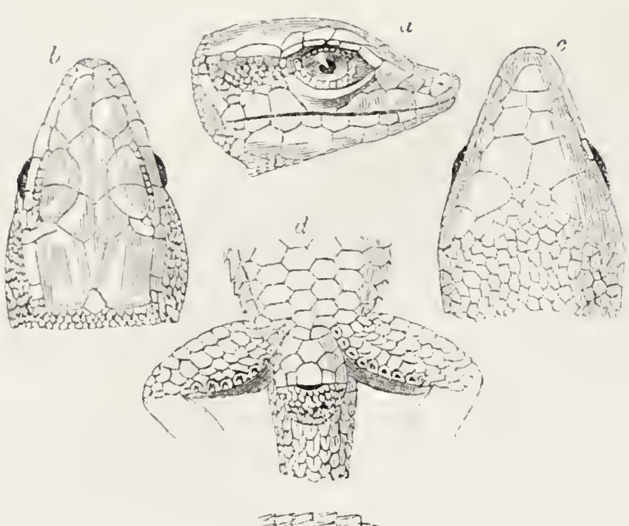
This serpent-like lizard is a native of northern Africa bordering the Mediterranean, of the Morea, Dalmatia, and southern Siberia. Scheltopusic is the name given to it by the natives of the desert of Naryn near the Volga. Its favourite haunts are wooded valleys, and places covered with brushwood and thick vegetation, affording it secure concealment. It feeds on insects, small lizards, nestling birds, and chases its prey like a snake, darting along in a series of sinuous flexures. When alarmed it instantly plunges beneath the dense brushwood and is lost. This species was found to be common in the Peloponnesus by the party conducting the 'Voyage Scientifique en Morée.' The first discovered was observed basking in the rays of the vernal sun, and had evidently but lately emerged from its winter retreat. It was instantly attacked and killed, but great was the surprise of its destroyers, who supposed it to be venomous, when they found it destitute of poison-fangs.

Subsequently many individuals were caught alive, and kept in rooms, where they soon became reconciled to the captivity, evincing a quiet inoffensive disposition. They were fed upon hard-boiled eggs; but on one occasion a captive scheltopusic got access to a nest of young birds, which it quickly demolished, doubtless with considerable relish.

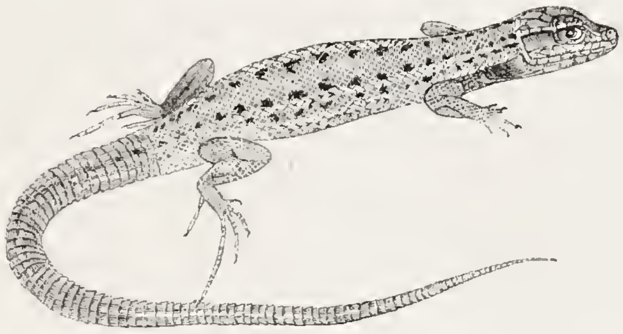
2195.—The Glass-Snake

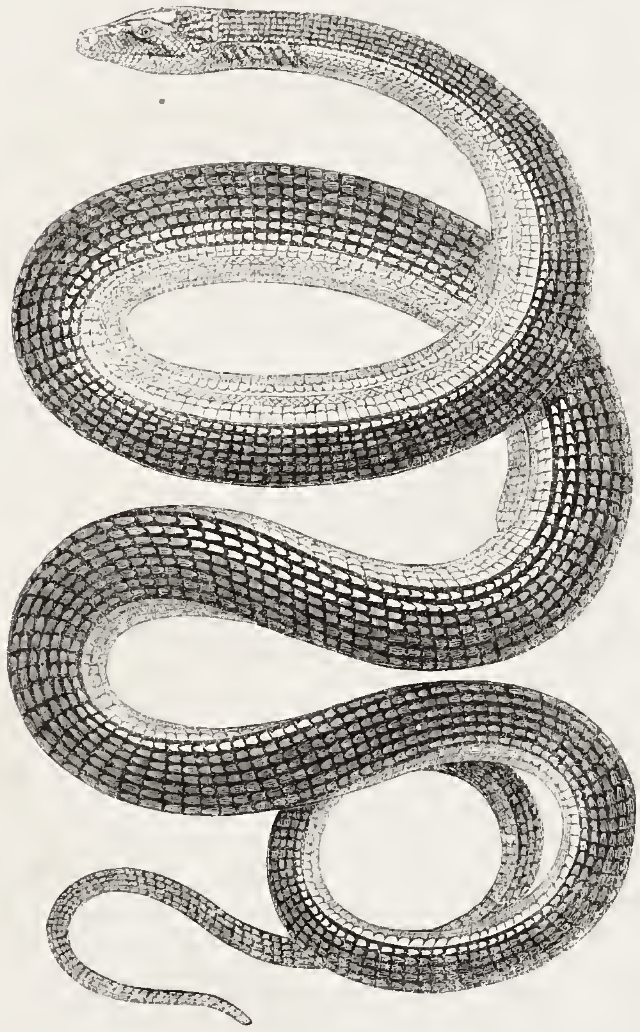
(*Ophisaurus ventralis*). In this reptile we have not even the rudiment of limbs, but from the points already referred to, namely, the presence of eyelids, the consolidation of the lower jaw, the auditory orifice, and the unsheathed tongue, snake-like as it is, it does not belong to the Ophidia. There are several rows of palatal teeth. The maxillary teeth are simple.

The name of Glassy Snake (Glassy Fragile, Pennant) has been given to this reptile from its extreme brittleness, the slightest touch causing it to snap asunder. It is a native of Carolina and the southern provinces of North America, and its manners closely resemble those of the scheltopusic. It frequents spots abounding in vegetation, and feeds on insects, small reptiles, frogs, &c. According to



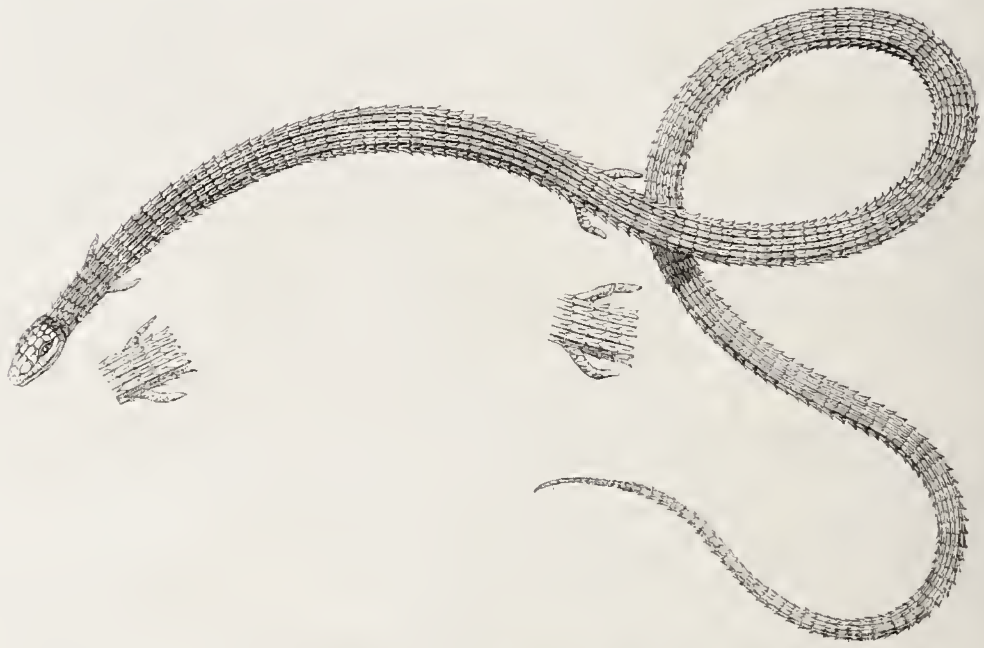
2189.—Details of Ophiops.

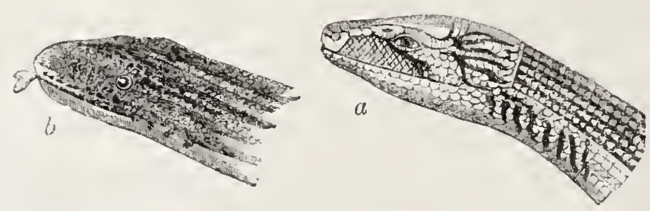

2188.—Ophiops.


2195.—Glass-Snake.

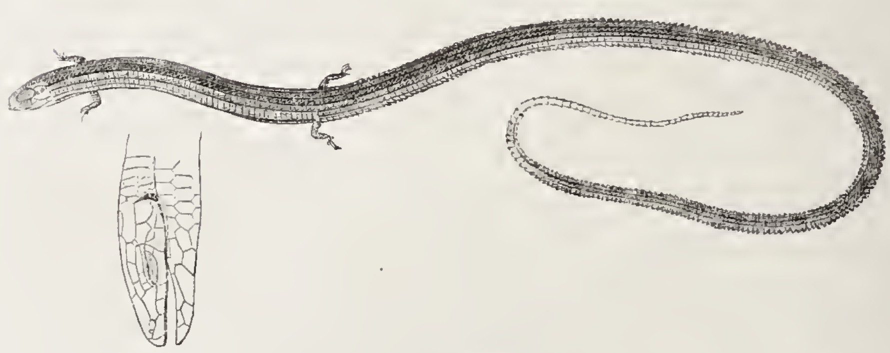

2191.—Four toed Snake Lizard.


2187.—Six-lined Tachydromus.

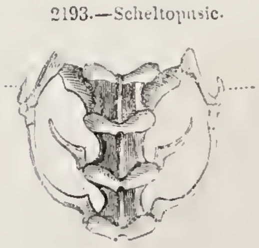

2192.—Anguine Lizard.



2196.—Heads of Glass-Snake.

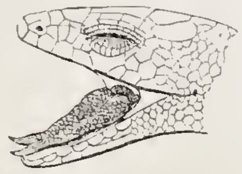

2190.—Four-toed Snake-Lizard.


2193.—Scheltopusic.

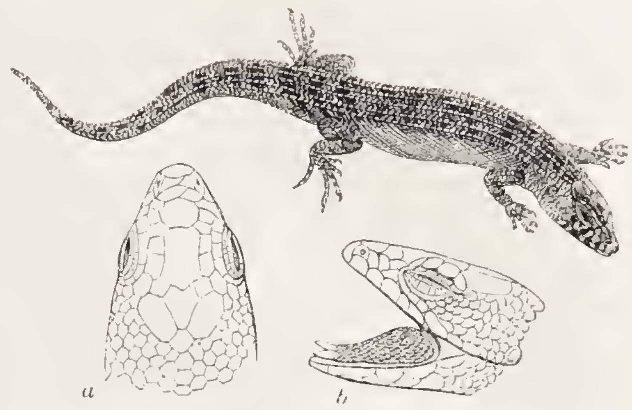

2194.—Pelvis of Scheltopusic.

2197.—Channelled Chirotes.

2203.—Capistrated Sphenops.



2204.—Sagra's Dipoglossus.



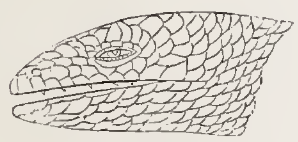
2199.—Cochin China Tropidophorus.

2198.—Dusky Amphisbæna.

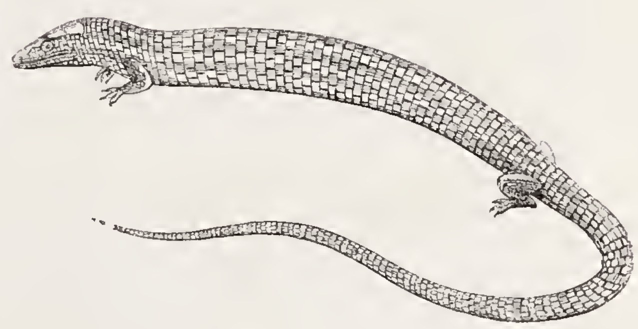
2210.—Common Zonurus.

2202.—Officinal Scink.

2201.—Officinal Scink.

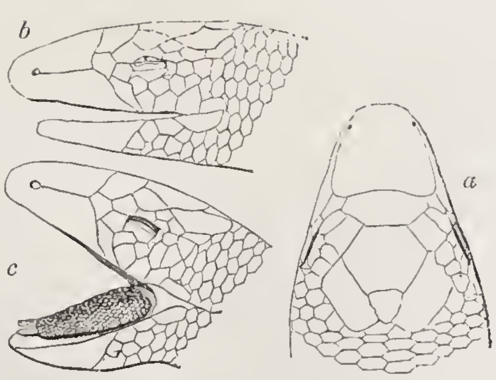


2207.—Slow-worm.

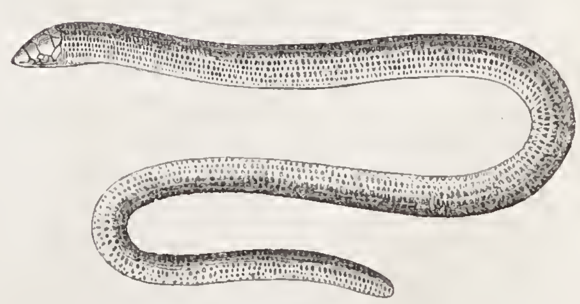


2206.—Common Seps.

2205.—Mabouya.



2209.—Head of Acontias.



2208.—Painted Acontias.

Catesby it appears earlier in the spring than any of the snake-tribe, and is numerous in sandy woods.

Fig. 2196 represents two heads of this reptile, *a* and *b*, of which the latter is depicted with the singularly-formed tongue exposed.

The glass snake is subject to considerable variations of colour. M. Bibron enumerates four varieties: the first is marked above with alternate longitudinal lines of black and yellowish, the under parts being white.

The second has the scales of the sides and neck black; those of the upper surface and tail brown, with a spot of black, and a streak of greenish yellow. The head is marbled with yellow on a black ground. Under parts white.

The third is chestnut with white spots, almost entirely encircled by black, generally arranged in transverse bands; the sides are mostly black, the edges of each scale being more or less spotted with whitish or reddish. Under parts pale orange.

The fourth is of a yellowish grey above, with a broad black median line from the back of the head to the end of the tail: while on the sides five more slender black lines alternate with white. Sides of the head and neck are mottled with white and black.

Catesby describes the colouring as yellowish green, spotted with black above. The tail is longer than the body, and the head is very small. "A small blow with a stick," he observes, "will cause the body to separate not only at the place struck, but at two or three other places also; the muscles being articulated in a singular manner quite through the vertebræ."

We shall now turn to the section Glyptoderma, the general distinguishing characters of which we have already detailed.

We may here add that the mode in which the teeth are implanted varies in this group. In most they are affixed by the side to the internal face of the maxillary bones; in others they are fixed on the ridge or summit of the bones, as in the genus Trogonophis.

2197.—The Channelled Chirotes

(*Chirotes canaliculatus*). Lacerta lumbricoides, Shaw; Chamæsaura propus, Schneider; Bimanus propus, Oppel; Bipes canaliculatus, Bonnat.

These singular animals, says M. Bibron, would be Amphisbænas, were they not provided with a sternum and two fore limbs—the only differences, in fact, by which the genera are distinguished; the body is nearly cylindrical, being somewhat flattened on its under surface; the head is of the same circumference, the former having the muzzle and borders of the mouth covered with plates, the only portions of the animal where the skin is not marked by depressions, dividing it into little quadrilateral compartments disposed in rings. The fore limbs, which alone exist, are placed at a short distance behind the head, and spring from the under surface of the neck; they are short, moderately robust, and terminated by five toes, of which four are well developed, and armed with robust, curved, and pointed claws: the fifth is a simple, scaly tubercle, destitute of a nail. Along the body, on each side, is a sort of suture descending from the shoulder to the origin of the tail: at the lower part of the abdomen is a row of small pores. The teeth are strong, conical, simple, and slightly curved backwards; the nostrils are lateral; the eye is very small; the muzzle arched; the tongue horny at the tip, and but little extensile.

This singular reptile is a native of Mexico, and measures eight or ten inches in length. The colour of the upper surface is yellow, each little square compartment having a mark of chestnut; the under parts are white. It was first described by Lacépède under the title "Le Cannelé." With respect to its habits, they are most probably subterranean, like those of the Amphisbæna; but on these points nothing appears to be definitely known. Fig. 2197 is accompanied by a delineation in outline of the Head and one of the Paws. There are no eyelids.

2198.—The Dusky Amphisbæna

(*Amphisbæna fuliginosa*). The genus Amphisbæna differs from Chirotes principally in the absence of limbs; the head and body are of uniform thickness, and the tail terminates bluntly, so that at a first glance it is not very easy to distinguish between the head and tail, more especially as the minute eyes are buried, and only to be detected through the horny plate that covers them, as little black dots, in which neither iris nor pupil is perceptible. In some species where the plates are more thick, they are scarcely to be observed. It is from this similarity of the head and tail that the natives of South America considered this reptile to have two heads, one at each extremity; and that if it was cut in two, so far from being killed, each distinct portion would continue to live, and that the two heads would mutually seek each other, and the bodies become reunited as if nothing had happened. Stedman, in his 'History of Surinam,' says, "Another snake which I observed here is about three feet long, and annulated with different colours. It is called Amphisbæna, from the supposition of its having two heads, and the truth is, from its cylindrical form the head and tail so much resemble each other that the error is almost pardonable; besides which the eyes are nearly imperceptible. This is the snake which, supposed blind, and vulgarly said to be fed by the large ants (termites), is in this country honoured with the name of King of the Emmets. The flesh of the Amphisbæna, dried and reduced to a fine powder, is confidently administered as a sovereign and infallible remedy in all cases of dislocation and broken bones; it being very naturally inferred that an animal which has the power of healing an entire amputation in its own case should at least be able to cure a simple fracture in the case of another." We may here observe that the term Amphisbæna (ἀμφίς, utrinque; βαίνω, incedo), though the animal has not two heads, is correct, as it is capable of crawling with the head or tail foremost with equal facility.

The head of the amphisbæna is blunt and short, and the muzzle resembles a small arched beak: sometimes it is rounded; it is covered with plates; the skin generally is divided into quadrilateral compartments disposed in circles round the body; and in some species a furrow runs down the middle of the back, and also along each side. At the lower part of the abdomen is a range of pores.

The specimens of amphisbæna which we have seen alive were dull and inanimate, with no grace or activity in their movements; they crawled slowly about, and, when handled, languidly twisted their bodies, and opened their mouths, but made no attempt to bite: their appearance was far from being attractive. One of these animals kept alive some time since in the Gardens of the Zoological Society, took milk very freely, and subsisted on it for six months.

The Dusky Amphisbæna is a native of Brazil and Cayenne, where it bores in the soft earth like a worm, working its way with considerable dispatch; it is harmless and inoffensive, living principally on ants and their larvæ and termites, and is often found in the mounds raised by these insects, or in their subterranean habitations. It measures nearly two feet in length, and the eyes are apparent as black dots. Its general colour is dusky brown.

MM. Duméril and Bibron enumerate ten species of amphisbæna, of which one is a native of Guinea, and one of North Africa, Spain, and Portugal; the rest are American. Besides, there are three species separated into a genus termed Lepidosternon, also natives of South America.

Family SCINCIDÆ (SCINKS or SKINKS).

The present family, "Les Lepidosaures" of Duméril and Bibron, presents us with characters distinct from those of our last; but through a series of forms it also conducts us to the serpents, the body becoming snake-like, and the limbs disappearing, till at length they are lost. The transition forms from the more typical genera are Evesia, in which the limbs are reduced to little footless appendages; one species is known, a native of India—Scelotes, in which there are no anterior limbs, and the posterior are divided into two small toes; one species (Sc. Linnæi, Bibron; Anguis bipes, Linn.) is known; it is a native of South Africa; Hysteropus (Bipes, Cuv.), presenting us with one species, of snake-like form, a native of New Holland; it has two rudimentary posterior limbs, in the shape of little flat appendages. In the Pygopus Cariococca, a snake-like reptile of South America, there are only rudimentary hinder limbs as in the preceding, minute flattened appendages. We then come to the genera Anguis (Blindworm), Acontias and Typhlops, in which the limbs have disappeared, and the figure is serpentiform. To the general character of the Sauria, the Family Scincidæ adds many peculiarities. The head is covered with large plates, of an angular figure, with the edges fitting together; the body, generally, is clad in scales of variable size and form, resembling a coat of mail, and arranged in quincuncial order, and overlapping each other like the pointed or rounded tiles of a roof; or like those of a carp, or of other osseous fishes. The tongue is free, fleshy, rather flat, notched at the tip and covered by scaly papillæ; the abdomen is cylindrical, without lateral folds, and clad with scales usually arranged in the same manner as those of the back. There is little or no distinction between the neck and body. We may here observe, with respect to the large angular plates of the head, that they do not occur in the Chameleons, the Geckos, Iguanas, or Varans, but are met with in the Teidæ, the true lizards, and the Chalcidæ; but, then, in the Teidæ and true lizards, the scales of the under parts are arranged differently to those of the back; and in the Chalcidæ, the scales are not only disposed so as to form circles or transverse bands, but a lateral fold is carried from the head to the origin of the tail. The limbs in the Scincidæ, when present, are short, and generally the whole surface of the scaling is smooth and polished. This group is found in the most arid districts of the hot and temperate regions of every portion of the globe; Europe, indeed, possesses but a limited number of species, which, be it observed, are not restricted in their geographical range to that quarter of the globe, but are far more widely distributed. The greatest number belong to Australia and the Polynesian Islands. We may now direct our attention to some of the forms of this extensive family.

2199.—The Cochin-China Tropidophorus

(*Tropidophorus Cocincinensis*, Bibr.). Leposoma Cocincinensis, Cuv.; Tropidosaurus montanus, Gray.

In the genus Tropidophorus the tongue is notched and squamous; the teeth are simple and cylindrical, none are palatal; the auditory orifices are closed by a tympanic membrane; the feet are all five-toed, and armed with slightly compressed claws; the tail is compressed and keeled; the scales of the upper parts are lozenge-shaped, each having a raised median carination, prolonged into a point behind. The species figured is a native of Cochin-China. Its general colour above is yellowish brown, with a tinge of olive, crossed with deep brown bars in the form of the letter X, in succession. The tail is spotted; the flanks present a row of white dots; under parts white. Letter *a* represents the head viewed from above; *b*, the head in profile, with the mouth open to show the tongue.

2201, 2202.—The Officinal Scink

(*Scincus officinalis*). El Adda of Bruce; Skink, Shaw's Barbary. Σκιγγος or Σκιγκος of the Greeks.

In the genus Scincus the tongue is notched and scaly; the teeth are conical, simple and blunt; there are teeth on the palate, which is longitudinally grooved; auditory orifices operculated; muzzle wedge-shaped; limbs four, with five toes on each; tail conical and pointed; general scaling, smooth, glossy, and fish-like.

The officinal Scink, of which there are three or four varieties, is a native of Arabia, Northern Africa, Egypt, Syria, and Abyssinia. It occurs also in Senegal.

In the 16th century this lizard was generally believed to be endowed with wonderful medicinal virtues, and consequently was an object of commerce; it was one of the most approved remedies in cases of debility, and was regarded as an infallible renovator of a shattered constitution. This superstition is of very ancient date; for Pliny states that these Scinci were imported into Rome, in a salted state (as Belon says they were in his time, 1551), and that their heads and feet were taken in white wine. He also cites Apelles as an authority for their efficacy, in the ease of wounds inflicted by poisoned arrows. We need not say that this lizard no longer maintains a place among the articles of the materia medica. Indeed, in Egypt and Arabia its reputation is gone. M. Alexandre Lefebvre, who collected, says M. Bibron, a number of individuals of this species, during an excursion in 1828 into the oasis of Bahrieh, informs us that this lizard "is met with on the hillocks of fine light sand, which the south wind accumulates at the foot of the hedges which border the cultivated lands, and of the tamarisks which strive to vegetate on the confines of the desert. There it may be seen tranquilly basking in the rays of a burning sun, or chasing from time to time the Graphypteri, or other coleopterous insects which pass within its range. It runs with considerable quickness, and when menaced buries itself in the sand with singular rapidity; excavating in a few instants a burrow of many feet in depth. When taken it endeavours to escape, but beyond this neither attempts to bite, nor to defend itself with its claws."

In all specimens of this reptile the lower and lateral parts of the head, body, and tail are silvery white, more or less pure. The upper surface varies in markings. M. Bibron enumerates the following:

Var. a.—General colour of the neck, back, and tail, yellow, or clear silvery grey, mixed with brown or blackish, which forms great spots dilated transversely, most frequently putting on the shape of transverse bands, the number of which is commonly seven or eight.

Var. b.—A yellow tint spread over the surface of the cranium. Neck, back, and a great part of the tail chestnut-brown, sprinkled with very small obscure whitish spots, two or three on each scale. Across the back five or six large white bands, with an irregularly dilated black spot at each of their extremities. These spots are not situated on the back, but on the most elevated part of the lateral regions of the trunk.

Var. c.—All the scales of the neck, back, and first half of the upper surface of the tail, silvery grey, widely radiated with white, with one or two brown spots on the posterior border of the radiations.

In Fig. 2202, *a* exhibits the fore-foot of this reptile seen from above.

2203.—THE CAPISTRATED SPHENOPS

(*Sphenops capistratus*), Head of.

We figure only the head of this singular lizard, which, as far as is ascertained, appears to be restricted to Egypt, where, according to Lefebvre, it is very common in the oasis of Bahrieh, at Labou, Quasr, and Bahoueit, and is to be seen in abundance on the ridges of rice-grounds, at the foot of hedges, and about the ruts of the miry roads of villages. It burrows so superficially that the slightest disturbance made by the feet of the passer-by lays open its retreat. It is very active in its movements, but when captured does not attempt to bite. It is a very remarkable circumstance, that an embalmed individual of this species was found by M. Lefebvre himself in the environs of Thebes. This he gave to M. Cocteau, who drew up an interesting memoir, which he was about to publish when death interrupted his labours. It is, however, given by MM. Duméril and Bibron. A similarly embalmed Sphenops is in the Egyptian museum of the Louvre.

2204.—SAGRA'S DIPOGLOSSUS

(*Dipoglossus Sagræ*), Head of.

We figure the head of this scincoid lizard so as to show the form of the tongue cleft at its apex, and covered above with papillæ like little scales.

This reptile is a native of Cuba, where it was discovered by M. Ramon de la Sagra. It lives in cool and humid places, where the soil is light; and is extremely quick and active in its movements. Neither in this nor the genus Sphenops are there any palatal teeth.

2205.—THE MABOUYA

(*Gongylus ocellatus*). The ocellated Scink, Mabouya Scink of Shaw; Tiliqua of Malta, Griff. 'Animal Kingdom,' Cuv.; Lacépède's Gallywasp, Gray; Scincus ocellatus, Meyer.

This little scincoid lizard is found along the shores of the Mediterranean, and is common in Sicily, Sardinia, and Malta; it occurs also in Egypt, and in the Island of Teneriffe. Dry and slightly elevated spots are its favourite abodes, and it conceals itself in the sand or under stones. Its food consists of insects, which it seizes after the manner of the true lizards; and though its form does not promise much agility, its movements are quicker than might be expected. When caught, it does not attempt to bite, but merely struggles to escape. It is subject to great variation of colouring, but is generally marked above by ocellated spots of black with a yellowish centre.

2206.—THE COMMON SEPS

(*Seps chalcides*). Seps tridactylus, Gerv., Gray, and others.

In this form we see a decided approximation to the limbless groups of the present family: the body is elongated and slender; the limbs are very short and small, and furnished with only three minute toes: the under eyelid is transparent; the teeth are simple, none on the palate; muzzle conical; tongue flat, squamous, notched at the point.

This smooth serpentiform scink is found in the south of France, in Italy and Spain, in the islands of the Mediterranean, and on the Mediterranean shores of Africa. It lives on worms, little snails and slugs, spiders, and all sorts of insects. It is viviparous, like our viviparous lizard or the Slowworm.

2207.—THE SLOWWORM

(*Anguis fragilis*). Blindworm, Head of.

The Slowworm, as a type of the genus Anguis, may be thus characterized:—body and tail cylindrical and obtuse; all the scales smooth, glossy, imbricate, nearly equal on the upper and under parts; head covered with nine larger plates; limbs reduced to mere rudiments beneath the skin; the mouth is small; the teeth minute, none on the palate: the eyes are small but brilliant.

The Slowworm is found over the greater part of Europe and the adjacent parts of Asia; and it is common in many parts of England, frequenting copses, orchards, old mouldering walls, and banks, where it delights to bask in the sun; it is a sluggish timid creature, and when handled, even roughly, seldom attempts to bite: if it does, its jaws are too small and feeble and its teeth too minute to inflict a wound: scarcely indeed does it make any impression, and the opinion that it is venomous is as absurd as it is erroneous. Let those who believe it put it themselves to the test, examine the creature's teeth, try their effect on any small animal, and not give up their common sense to the assertions of the ignorant.

According to Latreille, the food of the slowworm consists of worms and beetles, to which it adds frogs, small rats, and even toads; but this is a mistake: the undilatable mouth of the slowworm is incapable of taking in such prey; it could no more engulf a frog or rat than could the little viviparous lizard; it feeds to some extent, perhaps, on insects, but more particularly on worms and slugs, especially the latter; as was witnessed by Mr. George Daniel, whose account of the habits of the blindworm, in Mr. Bennet's edition of White's 'Selborne,' is very interesting. "A blindworm," he writes, "that I kept alive for nine weeks, would, when touched, turn and bite, although not very sharply; its bite was not sufficient to draw blood, but it always retained its hold until released. It drank sparingly of milk, raising the head when drinking. It fed upon the little white slug so common in fields and gardens, eating six or seven of them one after the other. It invariably took them in one position. Elevating its head slowly above its victim, it would suddenly seize the slug by the middle, in the same way that a dog will generally seize a rat by the loins. It would then hold it thus, sometimes for more than a minute, when it would pass its prey through its jaws, and swallow the slug head foremost. It refused the larger slugs, and would not touch either young frogs or mice. Snakes kept in the same cage took both frogs and mice. The blindworm avoided the water; the snakes on the contrary coiled themselves in a pan containing water which was put into the cage, and appeared to delight in it. The blindworm was a remarkably fine one, measuring fifteen inches in length; it cast its slough while in my possession: the skin came off in separate pieces, the peeling of the head being completed the last." In a state of nature, however, the cuticle, as in the snake, is shed in one entire everted piece. We have alluded to the brittleness of the tail of the viviparous lizard; the same brittleness characterizes the whole body of the slowworm. When alarmed or irritated, it forcibly contracts all its muscles, and breaks asunder upon the slightest attempt to bend it, or a trifling blow. It was from this circumstance that Linnæus gave it the name of *fragilis*. Like the other reptiles of our island, the blindworm hybernates, making a burrow under decayed masses of vegetation, in the soft earth, working its way to a considerable depth, the glossy smoothness of the scales facilitating its passage. In such burrows, Latreille assures us, it usually lives, coming up for the purpose of breathing, when it raises its head out of its hole, ready to retreat on the appearance of danger. Even in the winter it sometimes does this, though snow may be on the ground, if the sun be shining with a warm though transient gleam. We have often in summer seen it basking in old hedge-rows, and about crumbling old walls: it is easily captured.

As is the case with the viviparous lizard and the viper, the slowworm produces living young, the eggs being hatched just previously to the birth of the offspring they enclosed. This takes place in June or July. The young vary from six to twelve in number, and when first born are not two inches long; they soon, however, become active, and creep about in search of minute slugs and worms.

It is from the smallness of its eyes that this reptile has received the name of blindworm; they are, however, bright and quick, and defended by moveable eyelids; the minute teeth are slightly hooked; the tongue is rather broad, not very free, nor bifid, as in the snake, but merely notched at the tip. The general colour is lustrous silvery grey with a tinge of brown; a dark line runs along the spine, and obscure lines or rows of spots are carried down the sides; there is, however, considerable variety. The under parts are of a bluish-black, with white reticulations. The young are of a pale yellowish-grey above, black beneath: there is a little black dot on the top of the head, and another at the back of the head, whence a narrow black line is continued down the spine.

The adults measure from twelve to fifteen inches, but the proportionate length of the tail part varies, sometimes being not half the length of the body, sometimes nearly equalling it. This difference may in a great measure depend on sex, for in the lizards the body of the female is proportionately longer than that of the male.

2208.—THE PAINTED ACONTIAS

(*Acontias meleagris*). Anguis meleagris of Gmelin, Shaw, and others; Javelin Snake.

Referring to Fig. 2209, *a* represents the head as seen from above; *b*, the same in profile; *c*, the same with the mouth open to show the tongue.

In the genus Acontias the muzzle, which is conical, is sheathed in a large single case or horny mask, on each side of which open the nostrils; the tongue is flat, arrow-headed, squamous, and scarcely notched at the tip; teeth small, blunt; none in the palate. There is only one eyelid, namely, the lower. The tail is blunt. Scales smooth; limbs none.

The Painted Acontias, which is allied to our blindworm, which it resembles in habits, is a native of South Africa, and is very common at the Cape of Good Hope.

The general colour of this reptile is chestnut-brown, the margin of every scale being of a very light yellow, producing a prettily mottled appearance. The abdomen is white.

2210.—THE COMMON ZONURUS

(*Zonurus griseus*). Cordyle Lizard, Shaw; Cordylus griseus, Cuv.

In our notice of the ptychopleurous chalcidæ, we omitted this singular reptile, which is a native of South Africa and Senegal. The genus is thus defined by Mr. Gray:—Form lizard-like; tympanic membrane exposed; legs four. Femoral pores distinct; head depressed, broad behind; supra-orbital plate expanded. Tail depressed with whorls of large square-keeled spinous scales. Back with keeled subspinous scales, those of the under surface smooth. Toes five on each foot. The tongue is arrow-head shaped; free anteriorly, scarcely notched, and velvety. No teeth on the palate.

In this lizard the head is covered with large plates; the scales of the upper surface are quadrilateral, slightly imbricated from without inwards, forming close transverse bands; a furrow runs along the lower region of each side.

This species, the Rough-scaled Cape Lizard of Petiver, is very common at the Cape of Good Hope. It varies in colour, but is generally yellowish on the head and upper part of the limbs, orange on the back, sides, and tail. The under parts are white. The general form is thick and depressed, and the limbs are robust. It is not very rapid in its movements.

Before leaving the Sauria we must advert to some extinct forms, which at some remote epoch tenanted our globe, realizing the wildest dreams of poetic imagination, and forcibly impress upon our minds the fact of the great difference between many beings which once enjoyed life and light, and those which after the lapse of ages occupy their places. We shall first draw attention to the Pterodactyles. These extraordinary animals, which were regarded by Blumenbach as birds, and by Professor Hermann of Strasburg as intermediate between mammalia and birds, were ascertained by Cuvier to belong to the Sauria, or reptiles; and his views have been since amply confirmed. "They are," he says, "reptiles, of which the principal characters are a very short tail, a very long neck, the muzzle much elongated and armed with sharp teeth; the legs also long, and one of the toes of the anterior extremity excessively elongated, having probably served for the attachment of a membrane adapted for supporting them in the air; besides this there are four (or three) other toes of the ordinary size, terminated by hooked claws." The remains of these strange beings occur in the lithographic limestone of the Jura formation at Aichstädt and Solenhofen, in the lias of Lyme Regis, and the oolite of Stonesfield, Banz, &c. With them are mixed the remains of fishes, crustacea, and large insects, as libellulæ and coleoptera. Eight species are ascertained, varying in size from a snipe to that of a cormorant; viz., Pt. longirostris (Solenhofen), P. brevirostris (Solenhofen), P. crassirostris (Solenhofen), P. medius (Münster), P. Münsteri (Solenhofen), P. macronyx (Lyme Regis, and Banz in Germany), P. grandis (Solenhofen?), and P. Bucklandi (Stonesfield).

Our pictorial specimens are P. longirostris, P. brevirostris, and P. crassirostris.

2211.—THE LONG-MUZZLED PTERODACTYLE

(*Pterodactylus longirostris*). In all these Pterodactyles it will be observed that, while the head as a whole is very large in proportion to the body, the cranial cavity is very contracted; the orbits are large, and extensive facial apertures or hollows diminish much from the weight of the muzzle. In all the neck is very long, but particularly in the present species; the vertebræ being very elongated individually, with the exception of the first two. At the same time they are strong, and the head, neck, and jaws were no doubt moved by voluminous muscles. The length of the jaws armed anteriorly with sharp teeth is extraordinary; the lower jaw is slender. The vertebral column of the back and loins is stout, the tail short, and the ribs slender. This species equalled a woodcock in size, but the extent of its wing-membranes, from the length of the outer finger of the fore-limbs, must have been very great, and it may easily be imagined what force of muscle was required for agitating them.

2212.—THE SHORT-MUZZLED PTERODACTYLE

(*Pt. brevirostris*). In this small species the muzzle is short, and bird-like in its outline, which resembles that of the head of a goose, and the neck is accordingly abbreviated.

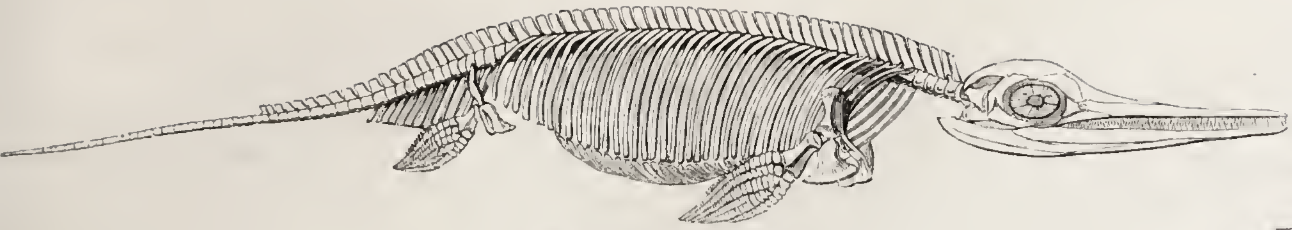
2213.—THE THICK-MUZZLED PTERODACTYLE

(*Pt. crassirostris*). In this species the muzzle is moderate and thick; the head exceeds the neck in

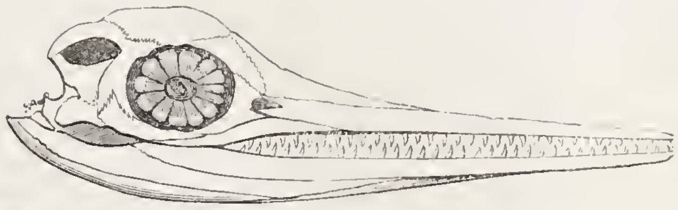
2211.—Long muzzled Pterodactyle.

2214.—Thick-muzzled Pterodactyle: restored.

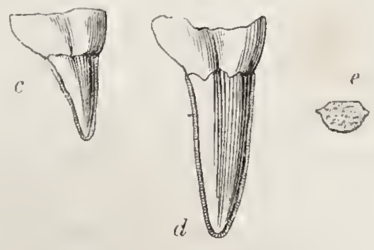
2212.—Short muzzled Pterodactyle.



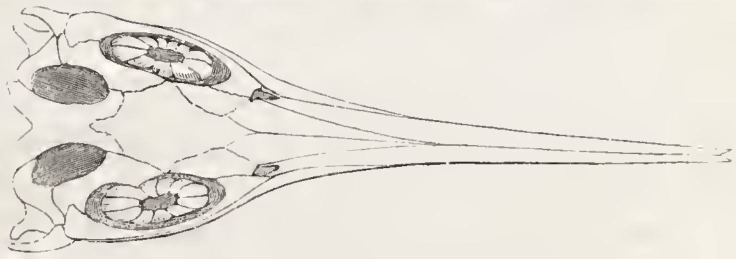
2222.—Ichthyosaurus.



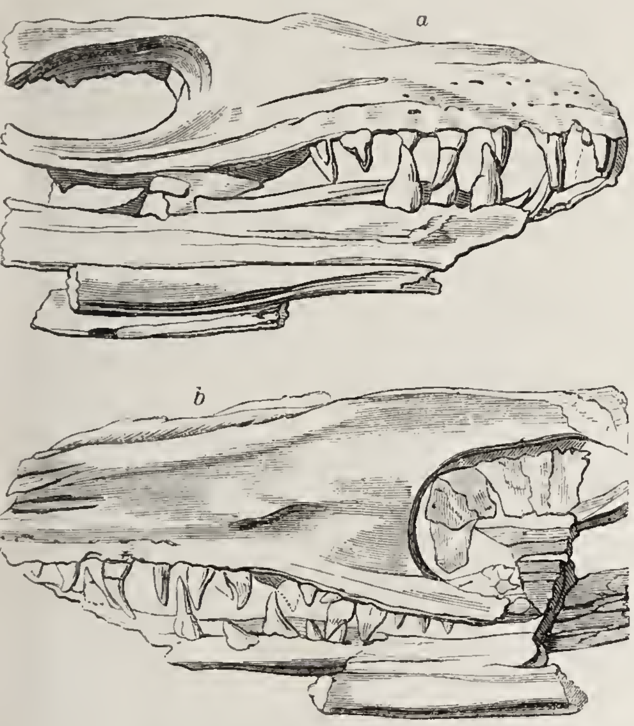
2215.—Head of Camper's Mosasaurus.



2217.—Teeth of Geosaurus.

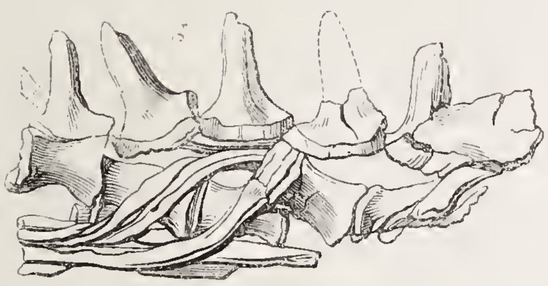


2225.—Upper Skull of Ichthyosaurus.



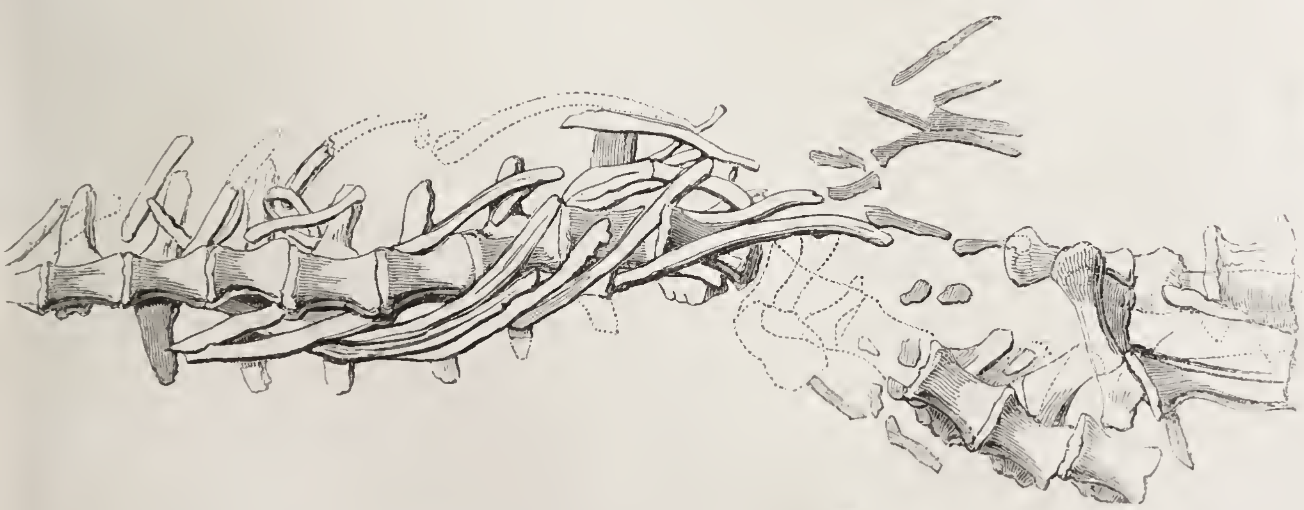
2216.—Head of Sömmering's Geosaurus.

2226.—Lower Jaw of Ichthyosaurus.

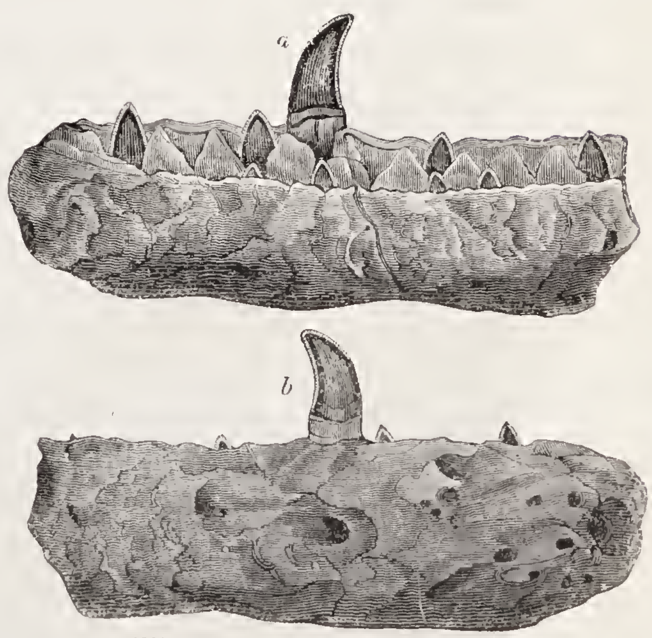


2219.—Portion of Fig. 2218.

2221.—Tooth of Megalosaurus.



2218.—Vertebral Column, &c. of Sömmering's Geosaurus.



2220.—Portion o Lower Jaw of Megalosaurus.

length, which consists of enormously stout vertebræ, exceeding those of the back; indeed the body seems disproportionately small to the volume of the head and neck; but the anterior limbs are very long, the paws large, and the finger for supporting the membrane greatly developed: and no doubt, when this membrane on each side was unfolded, it advanced so as to prevent the animal from necessarily drooping the head during flight, and thus maintained the balance of the body. Fig. 2214 is a delineation of this species, as restored by Dr. Goldfuss.

Dr. Buckland remarks that in one species (the Pt. macronyx, from the lias at Lyme Regis) there is an unusual provision for giving support and movement to a large head at the extremity of a long neck, by the occurrence of bony tendons, running parallel to the cervical vertebræ, like the tendons that pass along the back of the pigmy musk-deer, and of many birds. This provision, he observes, does not occur in any modern lizards, whose necks are short and require no such aid.

With respect to the habits and food of these flying lizards—these aërial sauria—we can only form a conjecture. Dr. Buckland thinks it probable that, besides having the power of flight, they might be capable of swimming also, as the Roussette bat of the island of Bonin (Pteropus), and that the larger species might possibly have fed upon fishes, darting at them as they rose to the surface and carrying them away; the smaller were probably insectivorous. He adduces the size and form of the hind foot, and also of the leg and thigh, to show that the Pterodactyles had the power of standing firmly on the ground, where, with their wings closed, they possibly moved after the manner of birds; and that they could also perch on trees and climb on rocks and cliffs, with their hind and fore feet conjointly, like bats and lizards.

Contemporary with these strange monsters—"chimæræ dire"—were monstrous ichthyosauri and plesiosauri ploughing the waters, while on the shore crawled gigantic crocodiles and tortoises, and huge crustacea.

2215.—CAMPER'S MOSASAURUS

(*Mosasaurus Camperi*). Head, fossil. In the calcareous hills of the valley of the Meuse near Maestricht, in the upper chalk in England, and also in the green sand of Virginia, occur the remains of a huge aquatic lizard, the head of which in many points resembles that of the Varans (Varanus Mersem) of the present day, but had teeth in the palate (pterygoid bones) as well as in the jaws, like the iguanas. This gigantic reptile, the remains of which have been by some mistaken for those of the whale, appears to have succeeded the ichthyosauri and plesiosauri, as the tyrant of the waters, its remains occurring in strata posterior to those in which the bones of these latter reptiles are imbedded. It exceeded twenty-five feet in length, and was expressly formed for cleaving the ocean with wonderful rapidity. The tail was compressed laterally, high and deep, in the vertical direction, and with this huge oar it lashed vigorously from side to side, sculling itself onwards. Instead of legs, it had four large flippers, like those of the plesiosaurus, and could therefore dive and mount again to the surface with the utmost ease. The ball-and-socket union of the vertebræ forming the spinal column allowed the utmost flexibility of movement, and thus was it organized for a life of aquatic rapine, destroying the largest fishes with a snap of its tremendous jaws. The head measures four feet in length; that of the largest living Varan five inches.

2216, 2217, 2218, 2219.—SÖMMERING'S GEOSAURUS

(*Geosaurus Sœmmeringii*). Fossil bones.

The remains of this reptile were found in the canton of Meulenhardt (near Mannheim), at the depth of ten feet, and at a little distance from the remains of a crocodilus priscus, by labourers employed to work the mines of granular iron, which fill the fissures of the calcareous schist. Near these relics were the shell of an ammonite, fragments of a bluish shell, and a great quantity of small scales. Other fragments of this reptile have been found in the Solenhofen slate, and we believe in America (marl of the green sand, New Jersey). This species, though allied to the preceding, differs in dental characters, and the orbit presents us with bony laminæ, which belonged either to the upper eyelid, or, as is more probable, to the sclerotic coat of the eye, a structure occurring in the recent varans, but not in crocodiles. It appears to have measured twelve or thirteen feet in length. Fig. 2216, *a* and *b* represent part of the head, which has been compressed; some of the sclerotic plates are still visible within the orbit, at *b*. Fig. 2217, *c*, *d*, *e*, teeth which had preserved their shining, hard, and brown enamel. Fig. 2218, a portion of the vertebral column, with fragments of ribs, &c. Fig. 2219, *g*, another portion of the vertebral column, also with fragments of ribs.

2220.—THE MEGALOSAURUS.

Portions of the lower jaw. The remains of this enormous reptile have been found in the oolitic slate at Stonesfield, the ferruginous sandstone of Tilgate Forest, and the oolite of Normandy. No entire skeleton has been discovered, but the fragments prove its colossal dimensions; and the structure of its teeth, that it was carnivorous. The thigh-bone of an individual formerly in the collection of Gideon Mantell, Esq., and now in the British Museum (from the Tilgate Forest), measures more than twenty inches in circumference, equalling in magnitude that of the largest elephant. Hence if the total length of this reptile was in proportion to the length of its extremities, it must in height have equalled our largest elephants, and have fallen but little short of the largest whales in length; making, however, every deduction, it would not have measured less than sixty or seventy feet. To such a reptile our hugest crocodiles are mere pigmies. Thigh-bones of smaller individuals are in the museum of Oxford. Of these the largest is nearly three feet in length, and ten inches in circumference at its smallest part. Hence, calculating according to the ordinary standard of the lizard families, the individual when alive could not have been less than from six to seven feet high, nor than forty feet long. The teeth of this animal were compressed, sharp, and arched backwards, with the edges finely denticulated; the germs of successive teeth (those taking the place of such as are worn out and fall) are in distinct sockets by the side of their antecessors.

Fig. 2220 represents *a*, the anterior extremity of the right lower jaw seen from the inside; *b*, the same presenting its outer side. Fig. 2221 shows the tooth of Megalosaurus, two-thirds the natural size. The dotted lines indicate the conical cavity containing pulp, within the root of the growing tooth. *a* is a transverse section, showing the compressed form, rounded back, and sharp cutting edge anteriorly.

2222.—THE ICHTHYOSAURUS

(*Ichthyosaurus communis*). It is in the lias and oolitic formations that the remains of the Ichthyosauri, or fish-lizards, abound. They have been found chiefly in the lias at Lyme Regis, but, according to Dr. Buckland, they exist along the whole extent of this formation throughout England from the coasts of Dorset, through Somersetshire and Leicestershire, to the coast of Yorkshire. They are found also in the lias of France and Germany. The range of the genus Ichthyosaurus, says Dr. Buckland, "seems to have begun with the Muschelkalk, and to have extended through the whole of the oolitic period into the cretaceous formation. The most recent stratum in which any remains of this genus have been found is in the chalk marl at Dover, where they have been discovered by Dr. Mantell. I have found them in the gault, near Benson, Oxon." The general form of this extraordinary animal may be easily understood from a survey of the skeleton as restored by Conybeare, Figs. 2222 and 2223, compared with Fig. 2224, the skeleton merely cleared from the lias in which it was imbedded. Some of the largest of these aquatic reptiles must have exceeded thirty feet in length. Let us suppose a grampus, with a sharp muzzle, with four broad paddles, and a long tail laterally compressed, deep and high, forming a caudal fin for lashing the water from side to side, large eyes, and tremendous jaws, and we have a tolerably faithful likeness of this tenant of the ancient seas. The whole organization of the skeleton demonstrates that the habits of the Ichthyosaurus were exclusively aquatic. The muzzle is elongated and pointed, and the teeth, amounting to one hundred and eighty in some specimens, are set in a furrow of the jaws, and their succession is managed as in the crocodile, by "the young tooth budding up at the base of the old tooth, where, as it grows, its pressure sets the absorbents at work; the base of the old tooth is thus partially removed, and, as the new tooth advances, is finally displaced to make room for its more efficient successor." The nostrils are placed just anterior to the orbits, in which we observe still remaining the osseous sclerotic ring, composed of distinct portions, placed in regular array. The eye was extremely large; and we can imagine how it glared with ferocity, as the monster darted towards his prey. Tremendous must have been the snap of the jaws when the animal seized his victim, and as they are long and slender, some liability to fracture, from the mere force of the muscles producing their sudden and forceful collision, might not unreasonably be expected; indeed, as Dr. Buckland well observes, a definite provision is made against this in the lower jaw, each ramus of which consists of six pieces of unequal length, placed together on the same principle as the plates forming the steel springs of carriages; they are most numerous and strong at the portion of the jaw where the greatest strength is required to be exerted, where in fact the main stress is, and are thinner and fewer anteriorly. This arrangement is well seen on the uppermost skull, Fig. 2225, and in the sketch of the lower jaw, Fig. 2226.

The neck is short, and the vertebral column very peculiar; it consists of more than one hundred vertebræ, which, instead of resembling those of saurian reptiles, are formed on the type of those of fishes; they are, in fact, concave anteriorly and posteriorly, and were doubtless filled by a thick fluid, and bound together by elastic capsules. "The sauroid type," observes Dr. Buckland, "is here departed from, in favour of a conformation demanded by the habits of the animal." It is farther noticed, he adds, by Sir E. Home, that the annular part of the vertebræ (enclosing the spinal cord above) is neither consolidated with the body of the separate bones, as in quadrupeds, nor connected by suture as in crocodiles, but remains always distinct, being articulated by a peculiar joint resembling a compressed, oval, ball-and-socket joint; and Mr. Conybeare observes that this mode of articulation cooperates with the cup-shaped form of the intervertebral joints in giving flexibility to the vertebral column, and assisting its vibratory motions; for had these parts been consolidated as in quadrupeds, their articulating processes must have locked the whole column together, so as to render such a motion of its parts impossible.

Every one knows that the spinal column of a recent fish maintains itself straight (when removed from the animal), and has a certain degree of springiness, or elasticity, by which, when bent, it returns to the same form; this results from the form of the vertebræ, the elastic capsules binding each to each, and the presence of the fluid which fills their cup-shaped cavities; it is very probable that in the Ichthyosaurus the same character prevailed.

Fig. 2227 represents the sternal arch and anterior paddles of this animal, in which it will be seen how provision is made for the strain of the latter, while breasting the rolling waves; at the same time the broad surfaces of the clavicles, besides adding to the strength of the chest, afford an ample and solid surface for the attachment of powerful muscles. The blades of the paddles, if we may use the expression, consist of polygonal bones disposed in regular order, exhibiting a tessellated surface.

It is, however, not only the external form and general habits of this being of an antique world that the anatomist has the means of ascertaining: he has also data from which he can deduce many important inferences with respect both to the internal structure and the nature of the food; indeed, the fossilized contents of the abdominal viscera, termed Coprolites, are often found in abundance between the ribs; and without entering into details, we may observe that the alimentary canal must have been very analogous to that of the sharks of the modern ocean: these coprolites consist principally of the scales of extinct fishes, and chiefly of those of a species (known in a fossil state) termed Pholidophorus limbatus; these scales are not only found in most of the coprolites, but dispersed throughout the entire region of the ribs. Fig. 2228 shows the ordinary form of the coprolites: *a* is a magnified scale of Pholidophorus limbatus imbedded therein (internal surface); *b*, the external surface of the same.

With respect to the tegumentary covering of the ichthyosaurus, we may conclude from the absence of plates or large scales, or the impressions of such in the lias, that it was simple and naked, resembling that of the grampus and other cetaceous animals. Thus then from the beds of lias in which they have been entombed for ages, have the relics of these aquatic Sauria "been summoned by the labours of the geologist to give evidence of events that passed at the bottom of the ancient seas in ages long preceding the existence of man." They tell of seas over which the canoe of the savage never floated, yet teeming with life; of a system of warfare and destruction in which man took no part; of alterations on the surface of our planet, themselves being the historic monuments; of changes in the forms of organic existence; of races commencing, spreading far and wide, and then blotted out of the catalogue of living things. This is no dream of fancy, no theory based upon an unstable foundation; the proofs are abundant, and such as to force conviction. We may picture to ourselves the huge ichthyosaurus ploughing the billows, driving the shoals of fish before him, pursuing them with unrelenting pertinacity, and thinning their numbers; we may picture him cruising about the mouths of rivers, and scattering terror in the finny hordes around; but a change has taken place, and the ploughman drives his team where the ichthyosaurus, entombed below, once revelled in his might.

Ten distinct species of ichthyosaurus are recorded by Professor Owen, viz.: Ichth. communis, Conybeare; intermedius, Con.; platyodon, Con.; Conchiodon, Owen; latifrons, König; latimanus, Owen; thyreospondylus, Owen; trigonus, Owen; tenuirostris, Con.; and acutirostris, Owen.

This admirable anatomist, comparing the paddles

of these enaliosaurians,* as they are termed, with those of the cetacea, comments on the development of the clavicles, and of the sterno-clavicular and coracoid arches in the former, an apparatus which would enable the animals, if stranded, to raise themselves up and regain the water, like seals, which the cetacea cannot do; and he adds, "Doubtless the anterior paddles might be subservient to locomotion not only in the water, but on land; that when applied to the resisting soil, they might react with due force upon the trunk. It is very conceivable that the ichthyosaurus, like the crocodile, may have come ashore to sleep, or to deposit its eggs, supposing them to have been oviparous, as the sum of their analogies deducible from their osseous texture would indicate. The hind paddles would also be serviceable in terrestrial progression, while in the strictly marine cetacea they can readily be dispensed with."

If the Ichthyosaurus ever came on shore, its motions must have been awkward and shuffling, not perhaps unlike those of the marine turtles, which perhaps also resemble it in its mode of depositing and burying its eggs.

2229.—THE PLESIOSAURUS

(*Plesiosaurus dolichodeirus*). We are here presented with another group of extinct Enaliosaurians, of strange form, the existence of which was contemporary with that of the Ichthyosaurus, their remains occurring in the same strata. If our readers refer to vol. i., p. 113, Fig. 510, an attempted restoration of the characteristic forms of animal vegetable life, during the deposition of the secondary series of strata, in which the oolitic formation is included, the Ichthyosaurus and Plesiosaurus will appear conspicuous; and some observations in p. 114, on the leading features of the primary, secondary, and tertiary periods, may be not uninteresting, read in connexion with the present account of these reptiles; as serving to give some idea of the period of their existence, relatively to that of beings belonging to the transition period; and also, that of animals approaching more nearly to, and often closely resembling the present tenants of our planet, and with which the tertiary strata are replete; creatures which, in the eyes of the geologist, have but recently passed away, to make room for successors, often, indeed, of the same order and genus.

The skeleton of the Plesiosaurus (Fig. 2229) was found in 1823, at Lyme Regis, imbedded in the shale or slate, which lies between the beds of lias limestone, and is crushed almost flat, probably by the deposition of the vast mass of stone above it. Its component parts, however, are easily made out; the bones of the body having suffered the most distortion. The small head, elongated neck, four ample paddles, and short tail, are, with the exception of one paddle, very apparent; the vertebræ of the lower part of the neck and chest, and the ribs, are disunited and scattered confusedly; yet from these may the skeleton be rebuilt, and a fair idea of the appearance of the living animal deduced. It was a reptile with large flippers, adapted for aquatic progression, with a flexible neck, exceeding the body in length, and terminated by a small head, the jaws being armed with formidable teeth. Dr. Buckland truly observes that the discovery of this genus forms one of the most important additions that geology has made to comparative anatomy. "It is of the Plesiosaurus," he adds, "that Cuvier asserts the structure to have been the most heteroclite, and its characters altogether the most monstrous, that have been yet found amidst the ruins of a former world. To the head of a lizard it united the teeth of a crocodile; a neck of enormous length, resembling the body of a serpent; a trunk and tail having the proportions of an ordinary quadruped; the ribs of a chameleon and the paddles of a whale. Such are the strange combinations of form and structure in the Plesiosaurus, a genus the remains of which, after interment for thousands of years, amidst the wreck of millions of the inhabitants of the ancient earth, are at length recalled to light by the researches of the geologist, and submitted to our examination, in nearly as perfect a state as the species that are now existing upon the earth."

Conybeare, who, when materials were far more scanty than at present, with singular acumen restored the skeleton of this wonderful extinct animal, thus deduces a rationale of its probable habits and manners: "that it was aquatic," he says, "is evident from the form of its paddles; that it was marine is almost equally so, from the remains with which it is universally associated; that it may have occasionally visited the shore, the resemblance of its extremities to those of a turtle may lead us to conjecture; its motion, however, must have been awkward on land; its long neck must have impeded its progress through the water, presenting a striking contrast to the organization which so admirably fits the Ichthyosaurus to cut through the waves. May it not, therefore, be considered (since in addition to these circumstances its respiration must have required frequent access of air) that it swam upon or near the surface, arching back its long neck like the swan, and occasionally darting it down at the fish which happened to float within its reach? It may, perhaps, have lurked in shoal water along the coast, concealed among the sea weed, and, raising its nostrils to the surface, from a considerable depth, have found a secure retreat from the assaults of dangerous enemies; while the length and flexibility of its neck may have compensated for the want of strength in its jaws; and its incapacity for swift motion through the water, by the suddenness and agility of the attack which they enabled it to make on every animal fitted for its prey, which came within its reach."—'Geol. Trans.' vol. i. p. 388, N. S.

We agree with the latter ideas expressed by the eminent writer; and it has often struck us that there is an analogy between it and the New Holland Chelodina (Chelodina Novæ Hollandiæ), a fresh water tortoise, with a serpentiform elongated neck, and which lurks in concealment, suddenly darting at and seizing such fish or reptiles as approach its place of ambush.

The species of Plesiosaurus determined are even more numerous than those of the Ichthyosaurus, amounting, according to Professor Owen, to sixteen in number—viz.: Pl. Hawkensii, Owen; dolichodeirus, Conybeare; macrocephalus, Conybeare; brachycephalus, Owen; macromus, Owen; pachyomus, Owen; arcuatus, Owen; subtrigonus, Owen; trigonus, Cuvier; brachyspondylus, Owen; costatus, Owen; dædicomus, Owen; rugosus, Owen; grandis, Owen; trochanterius, Owen; and affinis, Owen.

We shall now proceed to offer a few general observations on the bones of this genus, of which we have some interesting pictorial examples.

Figs. 2230 and 2231 represent the Skeleton of the Plesiosaurus dolichodeirus as restored by Conybeare, and convey a good idea of the animal's general form.

The head (Fig. 2232, *a*, the Profile: *b*, the Upper Surface) is not unlike that of the crocodile in general form, but is much smaller in proportion to the body; in the elongated form of the strong cranial bones, and also in other details, it exhibits, as Professor Owen remarks, an affinity to that of the Lacertian Sauria. The nostrils are situated just anterior to the orbits.

The usual complicated structure observable in the lower jaw of the Saurians appears also in that of the Plesiosaurus, the general form of which will be better conceived by referring to Fig. 2004 than by any merely descriptive details: *a* is the lower jaw seen from above; *b* is the same viewed laterally; *c*, the jaw seen from below. Fig. 2234 is a tooth, slightly magnified.

With respect to the ribs, their free extremities are connected together in the abdominal region by a series of intermediate slender pieces, so adapted to each other as to admit of a sliding motion of their component parts on each other, thus favouring the expansion of the cavity containing the lungs. These intermediate bones have been termed by Conybeare sterno-costal arcs. Their general outline is represented at Fig. 2235.

Fig. 2236 represents the Pectoral Arch of the Plesiosaurus, which is remarkable for strength and development. It consists of the sternum, the clavicles, and the coracoid bones (respectively lettered St., Cl., and Cor.); the latter are remarkably expanded. As the posterior limbs equal and sometimes exceed the anterior in size, the pelvic bones, as might be expected, are well developed, constituting an arch, as seen at Fig. 2237, consisting of the pubic bones, the ischiatic, and the iliac (respectively lettered Pub., Isch., and Il.), irrespective of the vertebræ.

With respect to the neck, it varies in the different species, as to the number of vertebral bones composing it, from twenty to forty.

As it would be out of place in our present work to enter into the minutiæ of osteological details, we shall cut short these observations, recommending to those who wish to enter deeply into the subject Professor Owen's Report on the Enaliosauria, or lizards of the sea, read at the British Association for the Advancement of Science, to the Geol. Trans., vol. v. 2nd series, 1840, and Geol. Proc. 1838.

Fig. 2238 represents the Relics of Plesiosaurus Macrocephalus as cleared from the block in which they were imbedded. In this species the head is comparatively larger than in Pl. dolichodeirus, and the neck shorter and much thicker.

Such then is an outline of the general characters of these reptiles of a former world, beings which cannot fail to excite the astonishment of all who for a moment contemplate their form and proportions. In the British Museum a splendid series of their remains strikes the attention of even the most careless visitors, and leads the reflective to throw themselves back upon a by-gone time, overleaping all historic periods, and calling up around them scenes totally dissimilar from any now displayed upon the surface of this planet. On the land grew plants such as Lepidodendron, Stigmaria, &c., now entirely unknown, towering pines, Zamiæ, and strange ferns; the morass was crowded with plants apparently resembling the equisetum; overhead sailed the Pterodactyles; various insects flitted about hovering over the marsh, along the borders of which wandered the huge Megalosaurus; the waters teemed with life; turtles, fishes, ammonites, nautili, echini, and cuttle-fish, with varied encrinites, and corals lived and perished in those seas, whose billows were breasted by Ichthyosauri and Plesiosauri, darting after their prey, and leaving a hoary track behind them. But silence reigned, save when some monster uttered a hideous hiss or roar, or lashed the water into foam: no birds saluted the morning sun with their voices or made the woods resonant of melody; a few perhaps might have existed, but they were thinly scattered: no deer or antelope browsed in rich meadows, no cattle wandered over the hills, no elephants came trampling their way through the forests; all was still and silent. If indeed any mammalia existed, like the birds they were few and local; for it is not till we arrive at the tertiary series of deposits that their remains in abundance prove the earth then fairly fitted for their general distribution. During the deposition of the oolitic strata of the secondary series, few spots perhaps were adapted for their reception. How different the animal and vegetable kingdoms of that far distant period, to the animal and vegetable kingdoms of the present day, and how different the relation of the land to the waters! What are islands and continents now, was a wide waste of ocean, or vast lagoons: but still have we in the solid rock, the monuments of time which proclaim (how impressively!) the primeval phases through which our planet has passed, and the changes and succession of organic beings on its surface. They prove, moreover, that at the period of the depositions taking place to which we immediately refer, viz., the oolitic, lias, and Jura limestone, the saurian order had assumed its full development, and exhibited a series of monstrous forms, the contemplation of which fills our minds with astonishment.

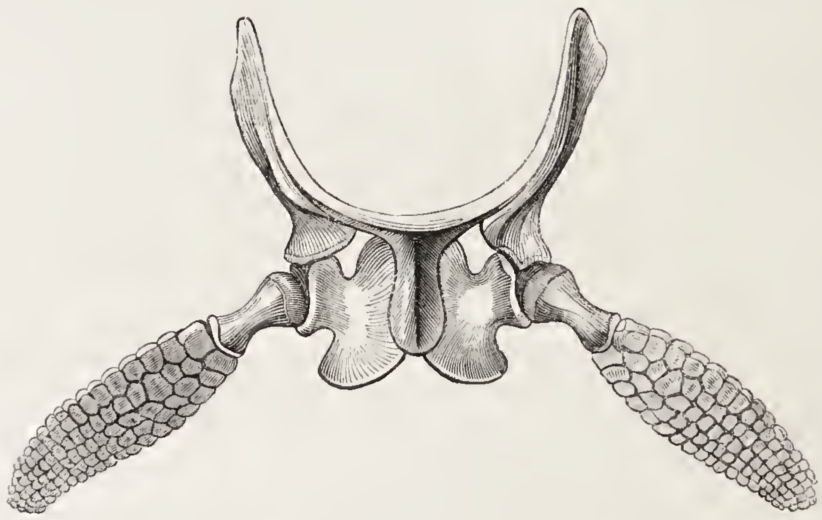
ORDER OPHIDIA (SERPENTS).

THE present order, Ophidia, abounds in species principally confined to the hottest regions, but extending also into the temperate latitudes, and even to climates where the cold of winter is considerable; in this sense they may be said to be spread almost universally, with certain exceptions. We may instance Ireland, where, indeed, it is said that there are no reptiles, the climate or soil being unfitted for their existence: this assertion, however, is not quite correct, for the frog is common; and though attempts to introduce the harmless ringed snake of our island have hitherto failed, it is because when discovered these reptiles are killed by the peasantry, who regard them with abhorrence. We quote from Mr. Bell the following communication, which he received from Mr. Thompson, explanatory of the reason why St. Patrick's malediction still operates in keeping the Emerald Isle clear of these animals:—"In this order Ophidia," he writes, "there is not now, nor I believe ever was there any species indigenous to Ireland. In the Edinburgh New Philosophical Journal for April, 1835, it is remarked:—'We have learned from good authority that a recent importation of snakes has been made into Ireland, and that at present they are multiplying rapidly, within a few miles of the tomb of St. Patrick.' I never," proceeds Mr. Thompson, "heard of this circumstance until it was published, and subsequently endeavoured to ascertain its truth, by inquiring of the persons about Downpatrick (where the tomb of St. Patrick is), who are best acquainted with these subjects, not one of whom ever heard of snakes being in the neighbourhood. Recollecting that about the year 1831 a snake (Natrix torquata) immediately after being killed at Milecross was brought by some country people in great consternation to my friend Dr. J. L. Drummond, I thought this might be one of those alluded to, and recently made inquiry of James Cleaveland, Esq., of Ruth Gael House (county Down), twenty-five miles distant in a direct line from Downpatrick, respecting snakes said to have been turned out by him. I was favoured by that gentleman with the following satisfactory reply: 'The report of my having introduced snakes into this country is correct; being curious to ascertain whether the climate of Ireland was destructive to that class of reptiles, about six years ago I purchased half a dozen of them in Covent Garden Market, in London; they had been taken some time, and were quite tame and familiar. I turned them out in my garden: they immediately rambled away; one of them was killed at Milecross,

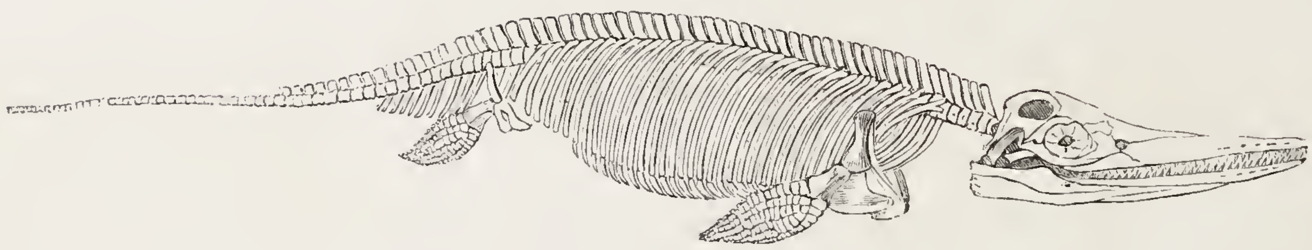
* ἐνάλιος, marine; σαῦρος, a lizard.

2224.—Ichthyosaurus.

2228.—Coprolite of Ichthyosaurus.

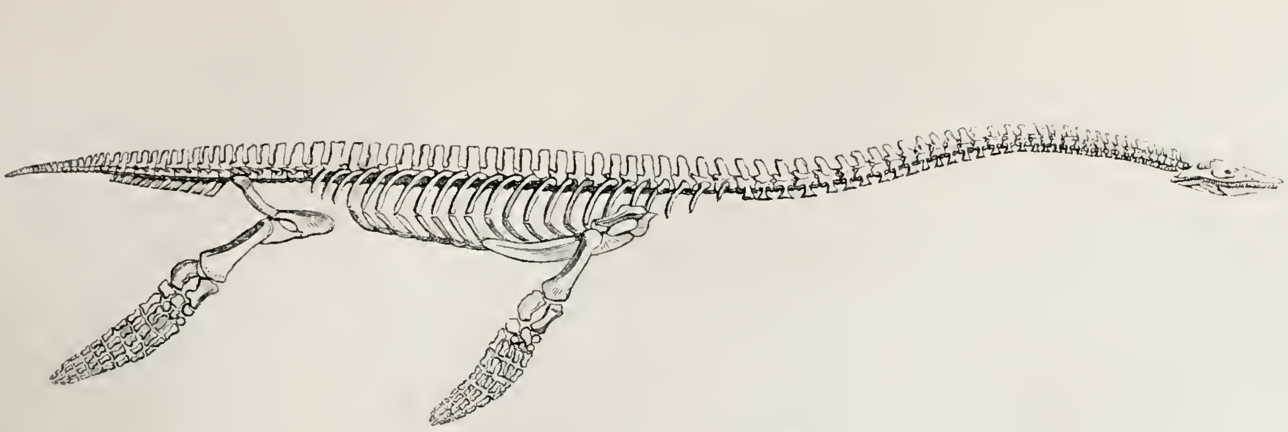


2227.—Sternal Arch and Anterior Paddles of Ichthyosaurus.

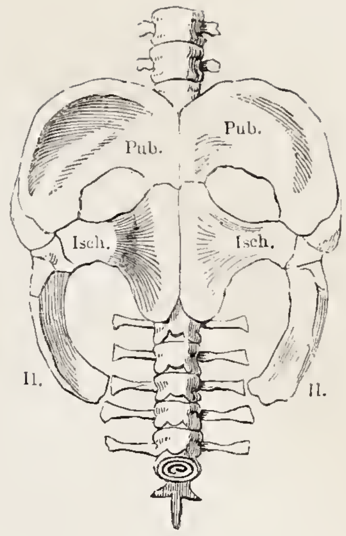


2223.—Ichthyosaurus.

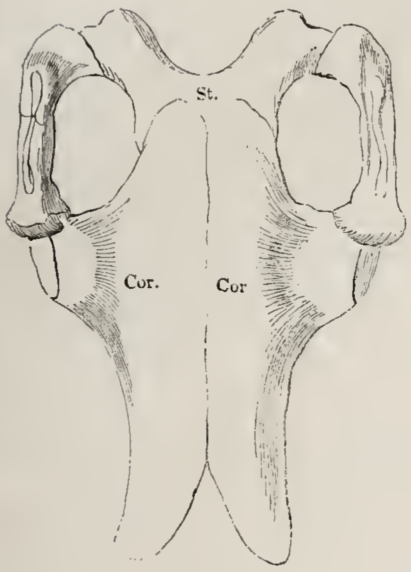
2229.—Plesiosaurus, as found at Lyme Regis.



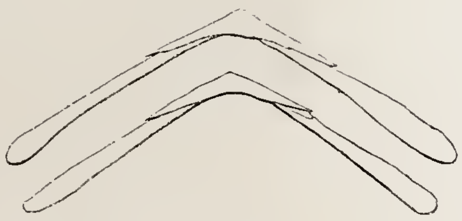
2230.—Skeleton of Plesiosaurus: restored.



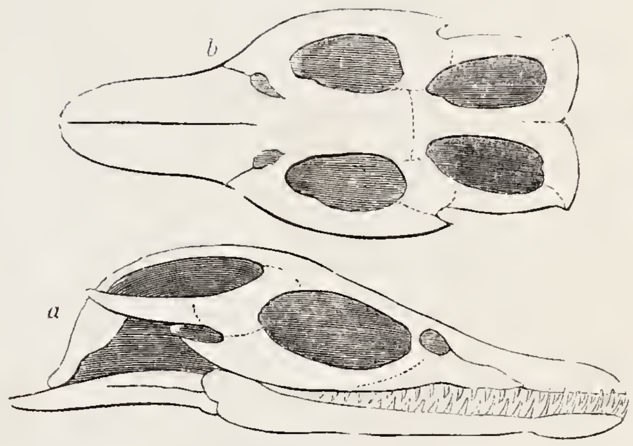
2237.



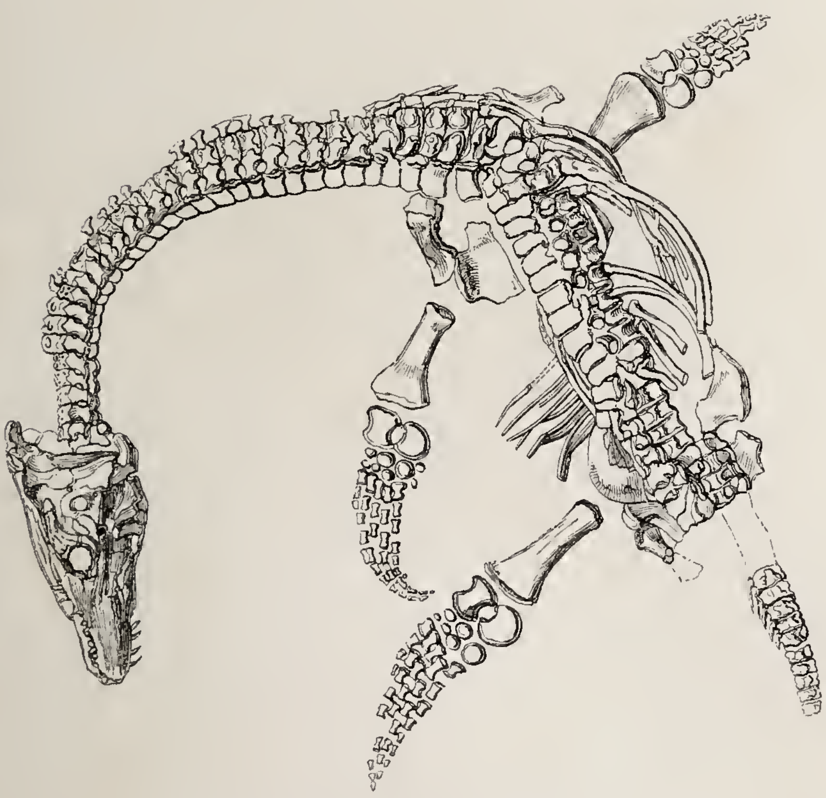
2236.



2235.



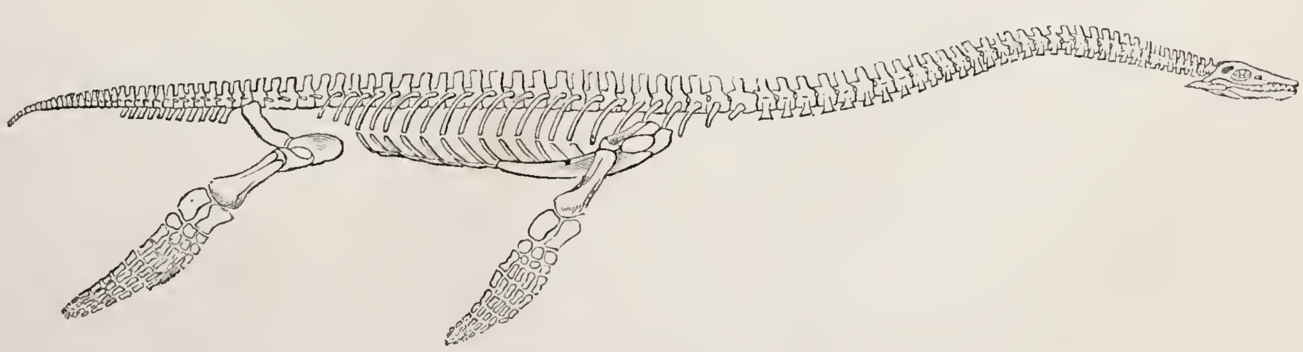
2232.—Head of Plesiosaurus.



2238.—Plesiosaurus: as imbedded.

2233.—Lower Jaw of Plesiosaurus.

2234.



2231.—Skeleton of Plesiosaurus: restored.

three miles distant, about a week after its liberation, and three others were shortly afterwards killed within that distance of the place where they were turned out, and it is highly probable that the remaining two met with a similar fate, falling victims to a reward which was offered for their destruction.'" It would appear then that though the snake is not indigenous in Ireland, there is nothing in the climate to prevent its naturalization.

There are no snakes in New Zealand, but on one occasion several dead sea-snakes were driven on the coast, to the consternation of the natives: one of these was presented to the Zool. Soc. See 'Proceeds.' 1838, p. 4.

In the great Polynesian groups of islands these reptiles are not found, with a remarkable exception, recorded by the late Mr. Williams, of the London Missionary Society, whose tragical fate is so well known. In his narrative he thus writes respecting the Samoa Islands, often termed the Navigators:—"Snakes also, which are unknown at the Tahitian and Hervey groups, abound here; I was informed that there were several species of them, some of which are beautifully variegated. Those procured for me were of a dark olive colour about three feet long. There are also water-snakes, some of them beautifully marked with longitudinal stripes of yellow and black, and others with rings alternately white and black. The natives esteem both the land and sea snakes good food. In the disorder occasioned by the leak in our ship, and her subsequent sinking at Tongatabu, I lost my snakes and many other curiosities which I was conveying home." To this he adds the following information: "Very large lizards are found on the mountains of Savaii and Upolo; and from the description I received I should conclude they were guanas. None, however, of these reptiles are venomous.* Another peculiarity in the natural history of the group is that a wild dog is found in the mountains; I regretted exceedingly that I could not obtain one. From the description I received it appears to be a small animal of a dark dirty grey, or lead colour, with little or no hair and large erect ears."

Somewhat unsatisfactory and unsettled are the genera into which the order Ophidia is divided; it may be observed, however, that these reptiles primarily resolve themselves into three distinct sections, viz., innoxious, poisonous, and aquatic, each section having its own characteristics.

Looking at the ophidian reptiles generally, we may describe them as of elongated form, with the head distinct, possessing great flexibility and strength. The mouth is wide and dilatable, the eyes are bright, there are no external auditory orifices, nor are there any limbs, but in some, as the Boas, the posterior pair, as we shall hereafter more fully explain, exist in the form of stylets, and assist the tail in grasping.

The top of the head is covered with plates, sometimes with scales, resembling those of the upper surface, which are small or moderate, more or less acutely pointed, and imbricated; these are termed *squamæ*. The scales of the under surface are broad and transverse, and the posterior edge of each overlays the anterior margin of the one succeeding. These transverse under-plates are termed *scuta*.

The eyes are exposed, being undefended by eyelids, but the surface of the cornea is covered by a transparent continuation of a delicate epidermic membrane which invests the scales, and which is frequently cast off, the animal emerging in brighter colours and with renewed strength and activity. This epidermic investment is known as the *slough* of the snake. If we look at the skeleton of the snake, and we take for our example that of one of the non-venomous snakes called pythons (see Fig. 2239), we shall be surprised at the beautiful arrangement of its component parts, at the number of the vertebræ and the ribs, and a little investigation will serve to show how admirably it is adapted for flexibility and strength.

If we attend first to the spinal column, of which two vertebræ are represented at Fig. 2240, we shall find that the bones are united together by ball and socket articulations, or in other words that the rounded head of each is fitted into a cup-like cavity of its predecessor, so that the whole column is a chain of these joints, by which the vertebræ are firmly locked together, but which at the same time permit the utmost degree of mobility compatible with the safety of the spinal chord. The various processes for the attachment of muscles are very prominent, and on the under surface, as seen at Fig. 2240, *aa*, are protuberances for the attachment of constricting muscles, by the action of which the python or boa crushes his victim.

To the vertebræ thus united are attached the ribs, and these are so ordered as to become efficient organs of locomotion; a circumstance first observed by Tyson, and recorded in his observations on the anatomy of the rattlesnake ('Phil. Trans.'). Sir Joseph Banks subsequently noticed it in the common snake.

From every vertebral bone, those of the tail excepted, arises on each side an arched rib, capable of a certain degree of motion, being articulated upon a convex protuberance, and acted upon by powerful muscles, which advance or retract it. Instead of being attached by their extremity to a sternum or breast-bone, each pair of ribs is connected to one of the abdominal scuta, by means of a slender cartilage and a set of short muscles. It is on the points of these ribs, which may be compared to the legs of a millipede, that the snake rests, and they act in progressive order, as we see the legs of that creature, each pair bringing forward the plate or scutum to which it is attached, and which may be regarded as their common foot. If a snake be allowed quietly to crawl over the hand, the progressive movements of the ribs may be easily distinguished, and also, if it be watched while crawling over any raised edge, as the back of a book, requiring the firm application of two or three scuta in succession as the body glides over it. According to Sir E. Home, the muscles which bring forward the ribs consist of five sets, besides other internal muscles.

The ordinary movement of a serpent is sinuous, its body assuming a series of gentle flexures, while the ribs, which are expanded, bring forward the abdominal scuta in succession; the posterior edge of each laying hold as it were of the ground, and becoming a fixed point from which to set out anew. When the snake proceeds rapidly, the flexures of its body are more ample and acute, and in this manner, making a series of undulations from side to side, it glides along with great velocity. These animals can also proceed by a series of bounds, by springing either from the tail or hinder half of the body, but their structure forbids their progress by vertical undulations, as they are often represented in the older works. Most can climb trees, some, indeed, are arboreal, and they swim and dive with facility and grace. Many serpents can leap or throw themselves to a great distance; in some instances they coil themselves up spirally, then instantaneously relaxing the muscles of one side, and at the same instant calling into action those of the outer side, they propel themselves with great quickness on their prey; the projectile impulse resembling that of a slender spring coiled up spirally, pressed on the table, and suddenly released.

The skull of the serpent presents us with a very curious structure. It is well-known that these animals swallow prey far exceeding their own body in bulk, and that the jaws adapt themselves to the mass, which is gradually gorged; they are, in fact, dislocated altogether during the act, and subsequently recover themselves. Let us look at the skull of a large python, represented at Figs. 2241, 2242, and 2243 (as seen from above, a palatal view, and in profile), we shall find that most of the bones composing it, instead of being locked together as in mammalia, are separate, and only retained in their places by skin ligaments and muscles. The upper jaw, see Fig. 2241, is composed of two distinct branches, separate from the bones of the skull, with a distinct intermaxillary bone between the points of each; and it will be found, moreover, that the bones of the face continue in their elemental state of subdivision, and are all disunited excepting by means of a fibrous elastic tissue. The lower jaw (Fig. 2243) consists also of two distinct lateral branches, disunited at the symphysis; each branch, which consists of two portions united by a lax kind of suture, is connected to the skull by two moveable bones, namely, an elongated tympanic bone, and a mastoidean bone; the attachment of these bones together, and to the skull, is merely by ligaments and muscles, so that when the jaws are straining in the act of engulphing prey, the articulations admit of a natural dislocation; at the same time the skin, muscles of the neck and throat, and the gullet, are capable of enormous extension, the animal appearing as if ready to burst, while the working of the muscles, stretched as they are, is very palpable. During this operation it might be supposed that the snake would be suffocated, but it is found that the larynx is protruded beyond the edge of the dilated lower jaw, as was first noticed by Mr. Broderip; and Mr. Green has detected two muscles specially adapted to draw the larynx forwards during the act of deglutition.

From what we have said it will be perceived that serpents do not masticate their food; hence are their teeth adapted for seizing and retaining living prey. We pass for the present a consideration of the poison fangs of venomous serpents, confining our observations to the teeth of the non-venomous. They are simple, conical, sharp, and directed backwards; above there are four rows, viz., a row in each branch of the upper jaw, including the intermaxillary bone, and a row on each side of the palate, rooted in the palatine and pterygoid bones; a row of teeth crowns the ridge of the anterior portion of each ramus of the lower jaw. The number of teeth vary in different species; sometimes they are nearly all equal in length, or, as in the Boas and Pythons, the anterior teeth are the largest, the decrease being gradual as they recede backwards; in some, however, the back teeth are the largest, and in others a few teeth exceeding the rest are in the centre of each row. In the genus Deirodon (Anodon, Smith) the teeth are so small as to be scarcely perceptible, and besides so soon lost that the snakes of this genus have been regarded as toothless. These reptiles feed almost exclusively, if not entirely so, on the eggs of birds; and, as Professor Owen observes, "If the teeth had existed of the ordinary form and proportion, in the maxillary and palatal regions, the egg would have been broken as soon as it was seized, and much of its nutritious contents would have escaped from the lipless mouth of the snake in the act of deglutition; but, owing to the almost edentulous state of the jaws, the egg glides along the expanded opening unbroken, and it is not until it has reached the gullet, and the closed mouth prevents any escape of the nutritious matter, that the shell is exposed to instruments adapted for its perforation. These instruments consist of the inferior spinous processes of the seven or eight posterior cervical vertebræ, the extremities of which are capped by a layer of hard cement, and penetrate the dorsal (upper) parietes of the œsophagus; they may be readily seen even in very young subjects, in the interior of that tube, in which their points are directed backwards. The shell being sawed open longitudinally by these *vertebral teeth*, the egg is crushed by the contractions of the gullet, and is carried to the stomach, where the shell is no doubt soon dissolved by the gastric juice" ('Odontography').

To the skull and teeth of the venomous serpents we shall invite attention when we come to our pictorial specimens of that dreaded group.

The lungs in snakes are either single, as in the common snake, or double, as in the python; the right lung, however, being the most extensively developed as a reservoir for air. The upper portion of the lung or lungs is spongy or cellular, and highly vascular, and it is in this portion that the change in the blood is effected; gradually the spongy structure, through the centre of which a free passage is left, merges into a thin membranous and but slightly vascular sac, serving as a reservoir for air.

The voice of serpents when excited is a hissing noise more or less loud; the tongue is long, moist, deeply forked, vibratory, and capable of being moved in all directions; when withdrawn it is received into a sheath, which can be either elongated or contracted. The sense of taste is evidently little developed, nor is that of smell very acute.

Serpents, like the reptile tribes in general, hybernate in temperate regions, but within the tropics their torpor depends on the continuance of drought; in this case, as Mr. Darwin well observes, the term hybernation ought to be exchanged for æstivation. "Near Rio de Janeiro," he says, "I was at first surprised to observe that a few days after some little depressions had been changed into pools of water by the rain, they were peopled by numerous full-grown shells and beetles. Humboldt has related a strange accident of a hovel having been erected over a spot where a young crocodile lay buried in the hardened mud; he adds the Indians often find enormous boas, which they call Uji, or water-serpents, in the same lethargic state; to reanimate them they must be irritated or wetted with water."

Serpents are extremely tenacious of life, and instances has been known in which the head severed from the body has not only long retained vitality, but bitten with fury: we had once a viper which, although deprived of the posterior portion of the body by the blow of a stick, lived for several days. With respect to the natural duration of life in these animals little is positively known, but doubtless it is very protracted, and years must elapse before a boa, which when first excluded from the egg does not exceed two feet in length, acquires that of thirty. The ancients believed that when they threw off their slough they renewed their youth, with a brighter robe, the index of fresh vigour.

It has been a belief of long standing that snakes possess the power of fascinating their victims; of paralyzing the bird or squirrel, or even of attracting it till it advances to the very jaws of the ferocious reptile. Dr. Smith, in his 'Zoology of South Africa,' speaking of the Boomslange (Bucephalus Capensis), which is generally found on trees, to which it resorts for the purpose of catching birds, adds, "The presence of a specimen in a tree is generally soon discovered by the birds in the neighbourhood, which collect round it and fly to and fro, uttering the most piercing cries, till one more terror-struck than the rest actually scans its lips, and almost without resistance becomes a meal for its

* This is not quite correct; the sea-snakes are exceedingly venomous.

enemy. During such a proceeding the snake is generally observed with its head raised about ten or twelve inches above the branch, round which its body and tail are intertwined, with its mouth open, and its neck inflated, as if anxiously endeavouring to increase the terror which it would almost appear it was aware would sooner or later bring within its grasp some one of the feathered group. Whatever may be said in ridicule of fascination, it is nevertheless true, that birds and even quadrupeds are, under certain circumstances, unable to retire from the presence of their enemies; and what is still more extraordinary, unable to resist the propensity to advance from a situation of actual safety, into one of the most imminent danger. This I have often seen exemplified in the case of birds and snakes, and I have heard of instances equally curious, in which antelopes and other quadrupeds have been so bewildered by the sudden appearance of crocodiles, and by the grimaces and contortions they practised, as to be unable to fly, or even move from the spot towards which the latter were approaching to seize them." There is nothing, however, mysterious in all this; the snake does not *mesmerise* its prey, but merely so terrifies it as to stupify it; besides, the victim may feel an impulse similar to that which urges many nervous persons on the edge of a precipice, or top of a lofty tower, to throw themselves down headlong, and which we have heard such describe as resisted with difficulty; so may the panic-struck bird feel an impulse to rush into the danger which it might escape by flight. After all we agree with Dr. Barton of Philadelphia, that it is generally in defence of their eggs or young the parent birds sacrifice their lives, while they vainly endeavour with their beak and wings to drive the intruder away.

The ancients were not only well acquainted with the serpents of Italy and Greece, but also with the huge pythons of other countries. Aristotle notices certain serpents of Lybia of enormous size, and narrates that some voyagers to that coast were pursued by individuals of such magnitude, that they overset one of the triremes or galleys, with three stages of rowers. The peculiar manner, too, in which these pythons enfold and crush their victim was also understood, and is delineated in the admirable statue of Laocoon and his sons vainly struggling against their fate; see Fig. 2244.

The story which is illustrated by this fine work,* is told by Virgil in the Second Æneid, and refers to the vengeance taken by Minerva on account of the insult offered by Laocoon, in hurling his spear at the wooden horse filled with armed men, which the Trojans drew through a breach of the walls into the city. One characteristic circumstance is mentioned by Virgil, namely, that after the snakes had destroyed their victims, they glided off to the temple, and sheltered themselves under the feet and buckler of the goddess; "Sub pedibusque deæ clypeique sub orbe teguntur:" and this leads us to glance at the antiquity and prevalence of serpent-worship, for it would appear that these animals were regarded as genii either of good or evil, and to be either reverenced or propitiated.

The Egyptians, as is well known, deified various species. Herodotus notices the Cerastes, which he erroneously calls harmless; when dead, these snakes were, he says, interred within the precincts of the temple of Jupiter Ammon and dedicated to that god. Another species, the Haje or Cobra de capello, was assumed as the emblem of Cneph or the good deity (ὁ ἀγαθὸς δαίμων), and among the bronze relics in the British Museum are figures of this snake with its expanded hood, and which were apparently some of the penates or household gods. It is also clear that the Egyptians were in the habit of sacrificing human beings to serpents; for in the tomb first discovered by Belzoni in Thebes, is a representation thus described by Dr. Richardson ('Travels along the Mediterranean,' vol. i.): "Here a human sacrifice stares us in the face; three human beings rest upon their knees with their heads struck off; the attitude in which they implored for mercy is that in which they met their doom, and the serpent opposite erects his crest, on a level with their throats, ready to drink the stream of life as it gurgles from their veins." The executioner is a priest, which concurs with other circumstances to show beyond dispute the religious character of the exhibition.

The sacred figure of the circle, wings, and serpent occurs in many of the monumental remains of Upper Egypt, and is represented abundantly among the sacred symbols.

To say nothing of the Babylonians and other people of antiquity who reverenced the serpent as an agathodæmon, or good genius, there are proofs of a like superstition in Greece and Italy. Fig. 2245 is the copy of a terra-cotta of Etruscan workmanship, in the Townley Gallery (Brit. Mus.), representing a female, perhaps the goddess Hygeia, feeding a serpent. Fig. 2246 is one of many similar representations at Pompeii, in which the lares or household gods are delineated in the form of serpents brooding over an altar. It is from a painting in the kitchen of a first-rate house, and the upper part of the tablet represents a sacrifice in honour of those serpent-deities, whose protection and custody over the provisions and cooking utensils are indicated by the border figures. We may also state that a picture found in Herculaneum represents a serpent twined round an altar, from which it is taking its food with a youth apparently worshipping it; the inscription is "Genius hujus loci montis." Similar representations are common. The Greeks, according to Justin Martyr, introduced the serpent into all their mysteries; and not only had the walls of Athens the snake-encircled head of Medusa sculptured upon them, but a live serpent was kept in the Acropolis.

Fig. 2247 is a portion of the Egyptian painting previously alluded to, exhibiting human sacrifices to a serpent; and Fig. 2248 represents several sacred symbols of the Egyptians, in which the serpent is conspicuous. It will be remembered that the Israelites worshipped a brazen serpent (seraph) till it was broken by Hezekiah. In Hindoo mythology this animal also has a place, and according to Colonel Briggs cobras are sometimes kept and worshipped in temples, where they are pampered with milk and sugar, by the priests, and become very tame.

If we turn to the New World we find that in Mexico and South America snake-worship was common. The ancient Mexicans in particular paid homage to the mighty boa, and not only had serpent idols of fine workmanship, but living boas of monstrous size were kept tame by the priests, and doubtless not without human victims; for Bullock in his 'Six Months in Mexico,' speaks of a great serpent-idol of good workmanship, and almost perfect, in the cloisters behind the Dominican convent, represented in the act of swallowing a human victim, which is seen crushed and struggling in its horrid jaws. To the worship of the boa we shall again allude when we come to notice that reptile.

We shall now pass on to our pictorial specimens of the ophidian race; beginning with the non-venomous.

Family COLUBRIDÆ (COLUBRINE SNAKES).

2249 (*b*), 2250.—THE RINGED SNAKE

(*Natrix torquata*, Ray). Tropidonotus Natrix, Kuhl; Coluber Natrix, Linn. As an example of the Colubridæ we may adduce the common ringed snake of our island and Europe generally. The head in this genus is distinct, oblong-ovate, depressed, and covered above with scuta; the gape is wide; the body long and slender; the squamæ are imbricate, lanceolate, and generally carinated; the abdominal scuta are simple; those under the tail double or biserial. Fig. 2251 represents the Head and Tail of the Common Snake.

Fig. 2249, exhibits—*a*, the Common Adder: *b*, the Ringed Snake, by way of comparison; they are our only two true ophidian reptiles.

The ringed snake is very harmless, and may be readily tamed; it is abundant in low moist woods, damp meadows, and hedge-rows, especially in the vicinity of water, to which it delights to resort, and in and around which its favourite food, the frog, is always to be procured. It often frequents gardens, attracted by the warmth of hotbeds and heaps of manure, in which the females deposit their eggs; for the same reason, as we can personally testify, snakes often frequent the sides and bases of limekilns composed of large rough masses of stone and turf, forming a thick mound, between the crevices of which they habitually conceal themselves and lay their eggs. White, in his 'History of Selborne,' complains that snakes lay chains of eggs every summer in his melon-beds, in spite of all that can be done to prevent them: the eggs, he adds, do not hatch till the spring following; hence it follows that where they are not laid in such places as manure-heaps, or in the crevices of limekilns, as above noticed, and so subjected to what may be termed artificial heat regularly kept up, they have to undergo the natural cold of our winter. In all cases most probably they are so secured as to be defended against severe frost. The eggs are invested with a membrane, and are eighteen or twenty in number, connected together, by a glutinous matter, in a long string or chain.

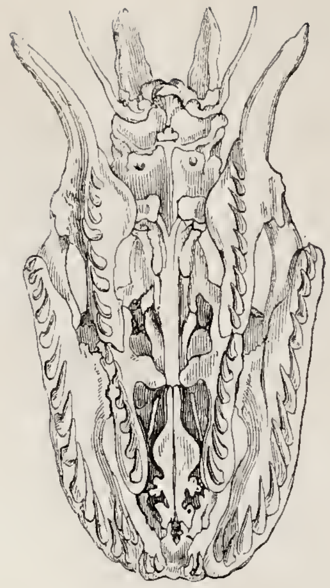
The snake swims well and very gracefully, with the head arched above the surface, and, as we have witnessed, it can remain a considerable time below. It is probable that snakes pursue frogs and water-shrews in this element; but they also delight in it, for we have watched them swimming about without any apparent object beyond the pleasure of the bath; we have also known them take to the water in order to escape when chased. In this fondness for water the snake differs from the blindworm, which avoids it, and from the viper, which prefers dry localities, seldom if ever voluntarily attempting to swim.

The snake is very voracious, and pursues its prey with great determination. It feeds on mice, nestling birds, and frogs, especially the latter, of which it is a great destroyer. We have several times seen snakes in the act of swallowing a frog, their jaws forced asunder, their neck swollen, and so absorbed in their laborious efforts to engulf their prey, all the while alive, that they have made no attempt to escape. In taking the frog, the snake generally seizes one of the hind-legs, and first draws it in, then the whole body, portion after portion, till the whole disappears. This in-drawing of the prey is not an act of simple suction, but is connected with the mechanism of the jaws, of which the bones are distinct, being united together, and to the cranium only by elastic ligaments. This plan ensures the necessary dilation of the mouth, for the prey swallowed generally exceeds the circumference of the snake; and next, allows the opposite side of each jaw, above and below, the power of independent motion: the upper jaw on each side has two rows of sharp teeth; the lower jaw has one row. The process is as follows:—The frog being seized, the snake advances as far as possible the corresponding branches of the upper and lower jaw of one side, fixing the teeth into the skin of the victim; this done, and a secure hold taken, it advances the branches of the opposite side, and so on alternately till the whole is gradually forced into the gullet, stretched almost to bursting. The poor frog is swallowed alive, and has been distinctly heard to utter its peculiar cry of distress some minutes after having been swallowed: this piteous cry it utters when chased by the snake, of which it has an instinctive terror; when fairly seized, however, it gives itself up to its fate, and seldom attempts to struggle. Mr. Bell relates a curious circumstance of two snakes seizing one the hind-leg, the other the fore-leg of the same frog, and continuing their inroads upon the victim till their upper jaws met, and they bit each other in turn. After one or two such accidents, the most powerful of the snakes commenced shaking the other, which still had hold of the frog, with great violence from side to side. In a short time the other returned the attack, and this was repeated till the one which had the slightest hold was regularly shaken off, when the victor swallowed his prey in quiet. The contest being over, a frog given to the unsuccessful combatant was immediately seized and swallowed. In taking birds, lizards, &c., the snake swallows them head foremost. After gorging its food it becomes lethargic, and continues in a state of inaction till the whole is digested, when it seeks a fresh supply.

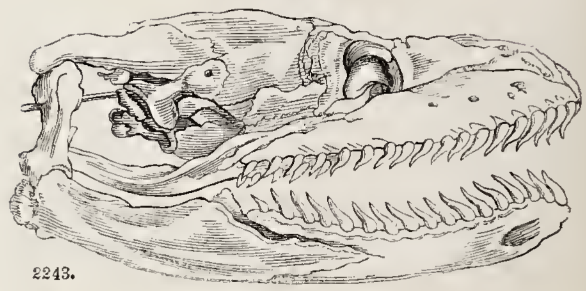
A celebrated naturalist, M. Schlegel, has ventured an opinion that snakes never drink: this is far from being correct. Dr. Cantor observes that the greater number of Indian serpents are partial to the water, and, with the exception of the tree-snakes, not only drink, but moisten the tongue, which, as this organ is not situated immediately in the cavity of the mouth, becomes two different acts. The same has been observed respecting African serpents, and the same applies to our common snake. Not only does it drink, but it is extremely partial to milk: Mr. Bell states that a tame one in his possession was accustomed to come to his hand every morning for a draught of milk, which it did of its own accord, and both in England and on the Continent it is accused of invading the precincts of the dairy in order to obtain its favourite beverage. Latreille says, "It is asserted that it is very fond of milk, and that it even makes its way into dairies for the purpose of drinking what is kept there, and further, that it sucks the teats of cows and sheep." The latter part of the story is decidedly the offspring of ignorance, but we believe the former part. We have heard it frequently affirmed by persons in the country, that snakes invade dairies for the sake of the milk, and that they have themselves witnessed them in the act of drinking it. Latreille states that this species sometimes surprises young birds; "for it climbs very easily: sometimes it suspends itself from the branches of trees, twisting its tail around them; sometimes it hooks on by means of its head placed between the forks of a twig." We have seen, on more occasions than one, the snake entwined in the midst of the close-locked branches of an old hedge, but we do not believe that it ever climbs trees, nor does its long, slender, fine-drawn tail appear, as far as our experience goes, to possess that grasping power so remarkable in the short tail of the boa or python; neither does it kill its prey by entwining them in its coils. When irritated, the snake hisses, vibrates its "double tongue," and elevates its head; its eyes sparkle, its body swells, and it emits a disgusting odour. It is, however, a timid animal, and is disposed rather to escape than oppose an enemy. That it can be tamed numerous experiments prove, and fur-

* The serpents are artists', not naturalists' serpents; it is strange that he who could copy so well the human figure could not work out the form of a snake.

2244.—Laocoon in the coils of snakes.



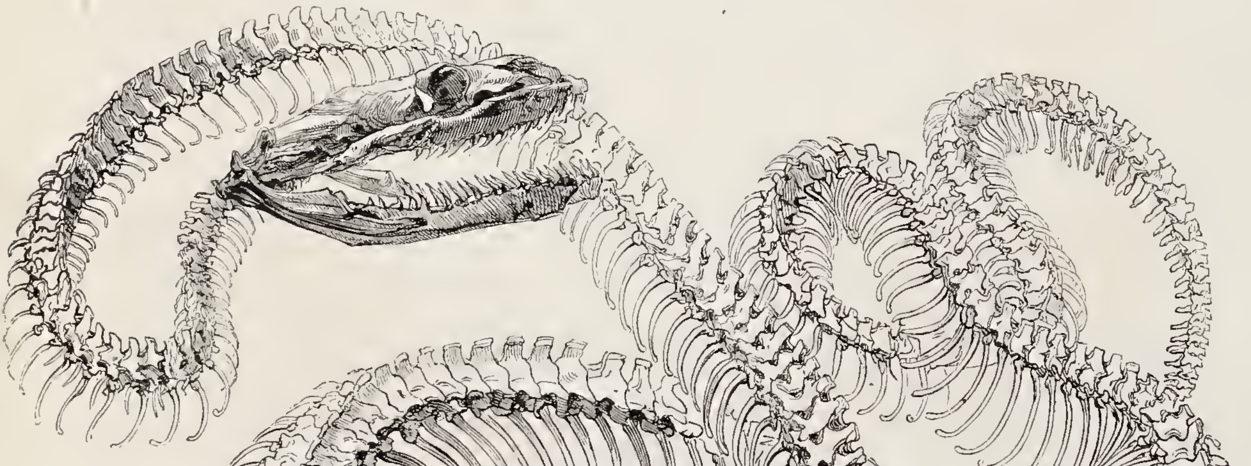
2242.



2243.

2241.

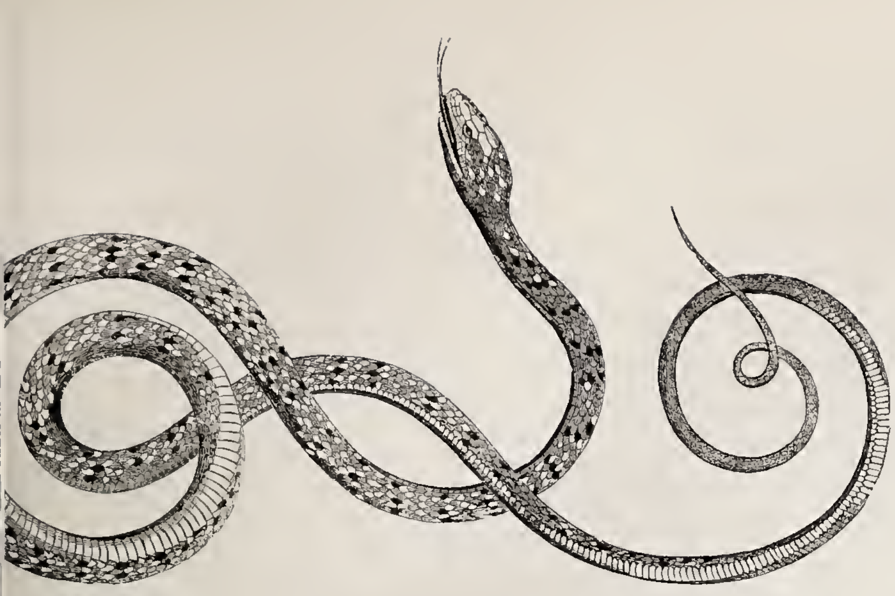
2241, 2242, 2243.—Skull of Python.



2239.—Skeleton of Boa Constrictor.

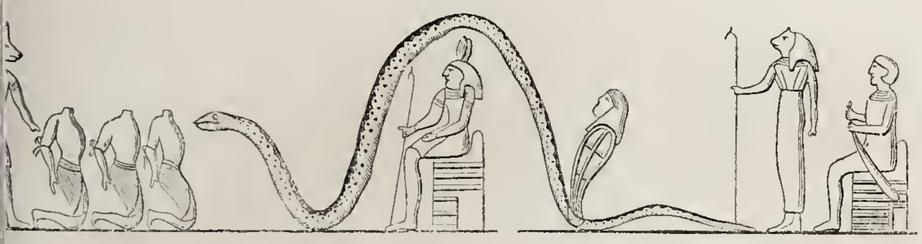
2245.—From the Townley Gallery.

2240.—Vertebræ of Boa.

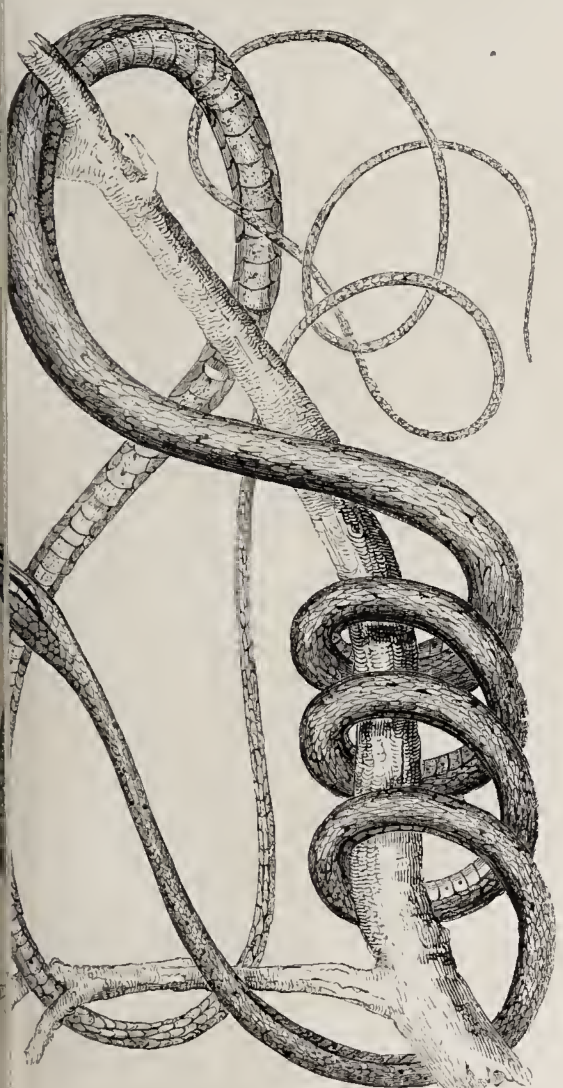


2253.—Purple Leptophis.

2248.—Sacred Symbols of the Ancient Egyptians.



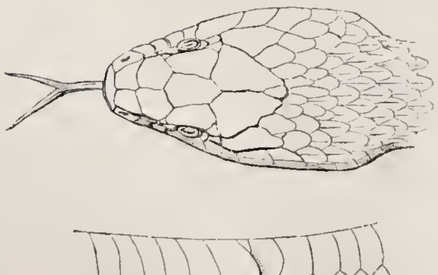
2247.—Egyptians offering Human Sacrifice to Serpents.



2252.—Golden Tree-Snake.

2249.—Common Adder and Ringed Snake.

2250.—Ringed Snake



2251.—Head and Tail of common Snake.

2246.—Serpent-worship: from Pompeii.

ther, that it acquires feelings of attachment to its protector. This was the case with one in Mr. Bell's possession, which when let out of its box would come to him and crawl under the sleeve of his coat, for the sake of the warmth. In the collection of the Zoological Society is the preserved skin of a snake which lived eleven years tame in the possession of a Mr. Christman, to whom it showed great attachment. "It is brought up," says Latreille, "in houses, and appears to be not insensible of the kind attentions of those who caress it, sipping saliva from their lips, and delighting to conceal itself under their dress, twining, without doing any injury, round their arms or neck. In Sardinia the young women, according to Lacépède, tame the ringed snake, feed it themselves, putting into its mouth the food they have prepared; and the inhabitants of the country regard these snakes as animals of good omen, suffer them freely to enter their houses, and would think that they had driven fortune away if they had put to flight these innocent little creatures." ('Hist. Nat. des Reptiles.')

Like all the rest, the ringed snake sheds its cuticle, assuming a more vivid colouring. The frequency of this change depends on the state of health and feeding of the animal. Mr. Bell states that he has known it cast its slough four or five times during the year; it is always thrown off by reversing it, the rent taking place at the neck: before this change the snake is inactive and blind, the cuticle covering the surface of the eyes, and which is shed with the rest, becoming opaque; the whole slough is perfect, the animal slipping out, and assisting itself by creeping through thick brushwood.

The snake passes the winter in a state of torpidity, choosing for a place of hybernation some sheltered retreat, either under decayed masses of wood, in the hollow roots of an aged tree, or beneath dense brushwood and dried herbage: here numbers often collect, coiling themselves together for the sake of preserving a due degree of temperature.

The ringed snake seldom exceeds three feet in length, though we have seen continental specimens approaching four feet.

The Prince of Canino, in his work on European reptiles, describes eighteen distinct species, besides varieties, exclusive of the present snake, as natives of the Continent; of these the largest is the elaphis quadrilineatus, which often attains to six feet in length. It is a native of Italy and Spain, and is probably the boa of Pliny.

We now come to certain snakes of arboreal habits, forming the group or subfamily leptophina of Mr. Bell. They are characterized by their extreme length, slenderness, and flexibility. The eyes are large; the gape is wide; the dorsal scales are oval, those of the tail very small.

With respect to these arboreal serpents Mr. Bell observes, that they all "live in woods, entwining themselves amongst the branches of the trees, and gliding with great rapidity and elegance from one to another. These habits, combined with the graceful slenderness of their form, the beautiful metallic reflexion from the surface in some species, and the bright and changeable hues in others, place them amongst the most interesting of the serpent tribe. Their food consists of large insects, young birds, &c., which the extraordinary size of the head, the width of the gape, and the great dilatability of the neck and body enable them to swallow, notwithstanding the small size of these parts in a state of rest: in a specimen in my possession of Dryinus auratus, for instance, the length of which is four feet nine inches, the diameter of the neck is hardly two lines.

"When the skin is distended either by food or during inspiration, the scales are separated from each other, and the skin which is of a different colour becomes visible in the interstices, producing a curious reticulated appearance. Notwithstanding the poisonous mark was affixed by Linnæus to the only species of Dryinus known to him (Coluber mycterizans) it is well ascertained that they are all of them perfectly harmless: and it is asserted of that species, that the children are in the habit of taming and playing with it, twining it round their necks and arms, and that the snakes appear pleased at being thus caressed."

2252.—The Golden Tree-Snake

(*Dryinus auratus*). This beautiful species is a native of Mexico; its general colour is yellowish grey, gleaming with a pale golden hue, and dotted with whitish and black. Mr. Bell records three species of this genus as American, two natives of India, and one of Java. One of the Indian species, D. nasutus, is remarkable for a snout-like, slender, moveable appendage projecting from the muzzle, which in all is elongated and acute.

2253.—The Purple Leptophis

(*Leptophis purpurascens*). This species is a native of India. Its colour is violet passing into green, with a golden lustre: a lateral and dorsal line of a paler hue. Head obtuse.

Three species of this genus are Indian, one American; two species are Australian.

2254.—The Boiga

(*Dendrophis Ahætulla*). In this genus, which is confined to India and Africa, the head is very slender, the eye large, the gape wide; the scales along the flanks are narrow, appearing as if placed in oblique lines, while those along the ridge of the back are large. In our illustration, *a* shows the characters of the head and lateral scales, and *b* the disposition of the subcaudal plates.

The Boiga is a native of Borneo, and is distinguished for slenderness, activity, and beauty. The upper part of the body is blue with a metallic lustre, passing into emerald green; a rich golden stripe runs down the spine, and another along each side. A black streak is behind each eye, and below this a white stripe occupies the edge of the upper jaw; under parts blue. The Boiga, says Latreille, darts with arrow-like rapidity, throws itself instantaneously into folds, ascends the trees with the greatest facility, and there wreathing itself amidst the branches, displays the golden azure of its scales, glittering in the sun. It is very gentle, and the children of Borneo play with it, and suffer it to twine around their limbs or body.

2255.—The Dipsas

(*Dipsas cyanodon*). In this genus the slender form and disposition of the scales is much the same as in Dendrophis, but the body is greatly compressed, and the head large, far exceeding the slender neck to which it is attached. The species are all harmless and arboreal. The genus Dipsas of Laurenti is synonymous with the genus Bungarus of Oppel, but not of Daudin, the latter appropriating it to a genus of venomous snakes. The ancients applied the term dipsas to a snake supposed to produce by its bite a burning thirst, the precursor of death.

We now pass from the arboreal to other forms of the colubrine family.

2256.—The Cape Lycodon

(*Lycodon Capensis*, Smith). This is a harmless little snake about fourteen inches long, is a native of South Africa, living in damp situations, where decayed masses of wood and vegetable matters afford it easy means of concealment; for, as Dr. Smith observes, it is not endowed with the power of effecting rapid movements. "When," says that naturalist, speaking of an individual captured among decayed wood near a small stream, "by the removal of some rotten masses the reptile was exposed, it moved slowly among the remaining ones in search of a place of concealment, and when it was interrupted in its advance it simply coiled itself up, without manifesting any disposition to resist the opposition offered; a similar course I had previously observed others of the same species pursue, when attempts were made to secure them, nor did they appear much in fear of their assailants."

2257.—The Oular Carron

(*Acrochordus Javanicus*). Oular Carron of the Javanese.

Though the only known species of the genus, this extraordinary serpent is the type of a distinct family (Acrochordidæ, "Les Acrochordes," of Cuvier). It is easily distinguished by the head being covered with small scales, as is also the whole of the body, but they are separate from one another, and each is marked with three small ridges; hence when it distends its lungs and body with air, the skin seems as if beset with minute tubercles at a considerable distance asunder; the body is thick, enlarging gradually as it proceeds, and then abruptly contracting at the base of the tail, which is short and slender. The tongue is short and thick. The general colour is black above, greyish white beneath and on the sides, which latter are spotted with black. It averages from six to ten feet in length. An individual exceeding eight feet was procured in Java by Hornstedt; it was a female, and when opened was found to contain five young ones perfectly formed, and about nine inches long. It was captured in a plantation of pepper, and the Chinese who accompanied Hornstedt cooked and ate its flesh, which they stated to be delicious. The stomach contained a quantity of half digested fruit, whence it has been inferred that, contrary to the rule among ophidian reptiles, it is of frugivorous habits. Cuvier, indeed, says, "Hornstedt a avancé à tort qu'elle vit de fruits, ce qui serait bien extraordinaire dans un serpent." But with deference to so great an authority, we may observe that no one, knowing only the general habits of the Saurian reptiles, but not acquainted with certain species that feed on leaves, would regard the iguana as herbivorous until the fact was ascertained; and so may this snake be equally herbivorous, though the rest are carnivorous.

Family BOIDÆ (BOAS, PYTHONS).

The Boidæ are huge snakes confined to the hotter regions of the globe, and formidable from their vast strength and mode of attack. They lurk in ambush and dart upon their victim, which in an instant is seized and enveloped in their folds, and crushed to death or strangled. For their predatory habits they are admirably adapted; their teeth (see Fig. 2258, head of Boa canina) are terrible, and produce a dreadful wound: the neck is slender, the body increasing gradually to about the middle in diameter, and then decreasing. The tail is a grasping instrument, strongly prehensile, and aided by two hook-like claws, sheathed with horn, externally visible on each side, beneath, just anterior to the base of the tail (see Fig. 2259, the under part of the base of the tail in the Boa canina). Though externally nothing beyond these spurs appear, internally is found a series of bones, representing those of the hinder limbs, but of course imperfectly developed; yet they are acted upon by powerful muscles, and can be so used as to form a sort of antagonist to the tail while grasping any object; they thus become a fulcrum giving additional force to the grasp, which secured thereby to a fixed point, gives double power to the animal's energy. These limbs removed are seen at Fig 2260: A represents the left limb of the boa seen anteriorly; B, the same limb seen posteriorly; *a*, the tibia or leg-bone; *b*, the external bone of the tarsus; *c*, the internal bone of the tarsus; *d*, the bone of the metatarsus; *e*, the claw-bone. Fig. 2261 represents the tail of the boa with its rudimentary limb on one side in situ with the muscles exposed: *a*, the vent; *b*, the hook or spur on the left side; *c*, the subcutaneous muscle; *d*, ribs and intercostal muscles; *e*, transverse muscle of the abdomen; *f*, bone of the leg enveloped in its muscles; *g*, abductor muscle of the foot; *h*, abductor muscle of the same. Hot morasses, swamps, the borders of rivers, and the tangled underwood of dank forests, are the favourite spots which these formidable serpents haunt; often half floating in the water, concealed amidst luxuriant herbage, with the tail grasping some branch or adjacent tree, they wait for their prey; the footsteps of their unsuspecting victim are heard as it comes to quench its thirst; the snake raises his head, glances upon his prey, then instantly lowers it, and prepares for the attack; all is silent, the creature draws near—it stoops to drink; suddenly, like a flash of lightning, the snake darts upon it; the water is lashed to foam; a cry of pain and terror, and all again is silent; the animal is quivering in the coils of the mighty snake; its life is soon crushed out. And now, gradually relaxing his accumulated folds and knots, the monster disengages himself and prepares to gorge the prey; he glides round it with eyes glaring upon it; ever and anon he touches it with his bifid quivering tongue, and soon commences to draw it in, beginning at the head, which first disappears; the mouth drips with a glutinous saliva; the jaws are all distorted; the working of each is visible, and also of the muscles of the head and throat; the skin of the neck is stretched, and appears as if it would burst the next instant, yet still the operation proceeds: so lost now is the snake to everything else, that it may be approached, struck, or even wounded, without ceasing its efforts, which increase with the difficulty occasioned by the bulky body of its prey. By slow and most energetic efforts, the whole at last is gorged; and now the bloated monster quietly seeks his accustomed retreat, and coiling himself round, sinks into a torpid state, which continues for a month; when reanimated and with renewed vigour he leaves his lair, and issues forth to lurk again in ambush, and seize another victim.

Not only quadrupeds, but even large fishes fall a prey to these serpents; they dart upon the latter as they approach the surface of the water, and drag them ashore. The boidæ indeed swim with great rapidity; but they climb trees, and, as Hernandez says, vibrate to and fro, being fixed by the tail to a branch, "snatching men and boys and other animals of that kind, and sometimes devouring them whole."

The species of the restricted genus boa are all natives of the tropical regions of America, and are characterized by the plates on the under surface of the tail being single. All are most beautifully coloured, and gleam in the sun.

Among the principal species are the following:—

2262.—The Emperor Boa

(*Boa constrictor*). Le Devin, Daudin; Constrictor formosissimus; Constrictor Rex Serpentium; Constrictor Auspex; Constrictor Diviniloquus. The latter names plainly indicate the superstitious feelings with which it was regarded by the Mexicans.

2263.—THE ANACONDA

(*Boa scytale*). Boa murina, Lin.; Boa aquatica, Prince Maxim. Mr. Bennet observes, that the term Anaconda appears to be of Ceylonese origin, and he applies it to the Python Tigris; we, however, follow Cuvier and most naturalists, who appropriate it to the present species.

2264.—THE BOJOBI

(*Boa canina*). Boa viridis, Boddart; Boa thalassma, Laurenti.

2265.—THE ABOMA

(*Boa cenchria*, Linn.). Boa cenchris, Gmel.; Boa cenchrya, Prince Maxim.

In Boa constrictor the head is covered to the end of the muzzle with small scales like those of the body; there are no pits in the plates along the jaws.

In Boa scytale the head has scaly plates from the eyes to the end of the muzzle; no pits on the jaw-plates.

In the Boa canina there are plates on the muzzle; the sides of the jaw have a kind of slit under the eye and beyond it.

In Boa cenchria there are scaly plates on the muzzle, and pits or dimples upon the plates of the jaws.

Endowed with powers which in a semi-civilized state of society must operate powerfully on the mind; at ease and freedom alike on the land, in the water, or among the trees; at once wily, daring, and irresistible in their attack, graceful in their movements, and splendid in their colouring,—that such creatures, to be both dreaded and admired, should become the objects of superstitious reverence, is scarcely to be wondered at. The ancient Mexicans regarded the boa as sacred; they viewed its actions with religious horror; they crouched beneath the fiery glance of its eyes; they trembled as they listened to its long-drawn hiss, and from various signs and movements predicted the fate of tribes or individuals, or drew conclusions of guilt or innocence. The supreme idol was represented encircled and guarded by sculptured serpents, before which were offered human sacrifices.

> "On a blue throne, with four huge silver snakes,
> As if the keepers of the sanctuary,
> Circled, with stretching neck and fangs display'd,
> Mexitli sate: another graven snake
> Belted with scales of gold his monster bulk."
>
> SOUTHEY.

Often, however, the divinity was represented in the form of a huge serpent, with a human victim in his coils, or half engulfed in his horrid jaws; and the priests had tame boas of great size, with which they were familiar, and which they suffered to wreath around them, and thereby inspiring the people with wonder, fear, and servile obedience. Finely has the late Dr. Southey, in his poem of Madoc, depicted such an exhibition and its effects. Neolin, the priest of the snake-god, is a prisoner in the hands of Madoc and his party, when

> "Forth from the dark recesses of the cave
> The serpent came; the Hoamen at the sight
> Shouted; and they who held the priest, appall'd
> Relaxed their hold. On came the mighty snake,
> And twined in many a wreath round Neolin,
> Darting aright aleft his sinuous neck,
> With searching eye and lifted jaw, and tongue
> Quivering; and hiss as of a heavy shower
> Upon the summer woods. The Britons stood
> Astounded at the powerful reptile's bulk,
> And that strange sight. His girth was as of man,
> But easily could he have overtopp'd
> Goliath's helmed head; or that huge king
> Of Basan, hugest of the Anakim.
> What then was human strength if once involv'd
> Within those dreadful coils! The multitude
> Fell prone and worshipp'd."

It is probably of the boa constrictor, the emperor, the devin, that Hernandez writes, under the name of Temacuilcahuilia, so called from its powers, the word meaning a fighter with five men. It attacks, he says, those it meets, and overpowers them with such force, that if it once coils itself around their necks it strangles and kills them, unless it bursts itself by the violence of its own efforts; and he states that the only way of avoiding the attack is for the man to manage in such a way as to oppose a tree to the animal's constriction, so that while the serpent supposes itself to be crushing the man, it may be torn asunder by its own act, and so die. We do not ask our readers for their implicit faith in this. He adds that he has himself seen serpents as thick as a man's thigh which had been taken young by the Indians and tamed; they were provided with a cask strewn with litter in the place of a cavern, where they lived, and were for the most part quiescent, except at meal-times, when they came forth, and amicably climbed about the couch or shoulders of their master, who placidly bore the serpent's embrace. They often coiled up in folds, equalling a large cart-wheel in size, and harmlessly received their food. In most accounts current respecting the mode in which boas and pythons take their food, the snake, after crushing its prey, is described as licking the body with its tongue and lubricating it with saliva, in order to facilitate the act of deglutition. It has been observed with justice that few worse instruments for such a purpose than the slender dark forked tongue of these snakes could have been contrived; and that, in fact, the saliva does not begin to be poured out abundantly till required to lubricate the jaws and throat of the animal straining to engulf the carcass. We have seen these snakes take their food, but they did not lubricate it, though the vibratory tongue often touched it; we must, therefore, withhold our credence from the common assertion.

The size attained by the boa is often very great, and larger individuals than any now seen occurred formerly, before their ancient haunts had been invaded by human colonization. One killed in Surinam by Captain Steadman, though asserted by the natives to be young, measured upwards of twenty-two feet in length, and yielded four gallons of fine oil, exclusive as much or more wasted.

A specimen apparently of the Boa scytale, called in Venezuela "La Culebra de Agua," or water-serpent, and also "El Traga Venado," or deer-swallower, which measures nineteen feet and a half in length, was presented by Sir Robert Ker Porter to the United Service Museum. He states that "The flesh of this serpent is white and abundant in fat. The people of the plains never eat it, but make use of the fat as a remedy for rheumatic pains, ruptures, strains, &c."

"This serpent," says Sir R. K. Porter, "is not venomous nor known to injure man (at least not in this part of the New World); however, the natives stand in great fear of it, never bathing in waters where it is known to exist. Its common haunt, or rather domicile, is invariably near lakes, swamps, and rivers; likewise close wet ravines produced by inundations of the periodical rains: hence, from its aquatic habits, its first appellation. Fish, and those animals which repair there to drink, are the objects of its prey. The creature lurks watchfully under cover of the water, and, whilst the unsuspecting animal is drinking, suddenly makes a dash at the nose, and with a grip of its back-reclining double range of teeth never fails to secure the terrified beast beyond the power of escape."

It would appear that boas are apt to be carried out to sea by sudden floods, and are sometimes drifted alive on distant coasts. The Rev. Lansdown Guilding (writing in the Island of St. Vincent) says, "A noble specimen of the boa constrictor was lately conveyed to us by the currents, twisted round the trunk of a large sound cedar tree, which had probably been washed out of the bank, by the floods of some great South American river, while its huge folds hung on the branches as it waited for its prey. The monster was fortunately destroyed after killing a few sheep, and his skeleton now hangs before me in my study, putting me in mind how much reason I might have had to fear in my future rambles through St. Vincent, had this formidable reptile been a pregnant female and escaped to a safe retreat."

The Pythons closely resemble the true boas, but have the subcaudal plates double; the muzzle is sheathed with plates, and those covering the margins of the jaws have pits. These snakes, which equal or exceed the boas in magnitude, are natives of India, Africa, and Australia. Pliny speaks of snakes in India of such a size as to be capable of swallowing stags and bulls; and Valerius Maximus, quoting a lost portion of Pliny's work, narrates the alarm into which the troops under Regulus were thrown by a serpent which had its lair on the banks of the river Bagradas, between Utica and Carthage, and which intercepted the passage to the river. It resisted ordinary weapons, and killed many of the men; till at last it was destroyed by heavy stones thrown from military engines used in battering walls: its length is stated as a hundred and twenty-three feet. Regulus carried its skin and jaws to Rome, and deposited them in one of the temples, where they remained till the time of the Numantine war.

Diodorus Siculus relates the account of the capture of a serpent, not without loss of life, in Egypt, which measured thirty cubits long; it was taken to Alexandria. Suetonius speaks of a serpent exhibited at Rome in front of the Comitium, fifty cubits in length.

Though we do not refuse credit to these narratives, it must be added that in modern days we have not seen serpents of such magnitude: yet they may exist. Bontius observes that some of the Indian pythons exceed thirty-six feet in length, and says that they swallow wild boars, adding, "there are those alive who partook with General Peter Both, of a recently swallowed hog cut out of the belly of a serpent of this kind." These snakes, he observes, are not poisonous, but strangle a man or other animal by powerful compression. The Ular-Sawa, or Great Python of the Sunda Isles, is said to exceed, when full-grown, thirty feet in length; and it is narrated that a "Malay prow being anchored for the night under the Island of Celebes, one of the crew went ashore, in search of betel nut, and, as was supposed, fell asleep on the beach, on his return. In the dead of the night his companions on board were roused by dreadful screams; they immediately went ashore, but they came too late, the cries had ceased—the man had breathed his last in the folds of an enormous serpent, which they killed. They cut off the head of the snake and carried it, together with the lifeless body of their comrade, to the vessel; the right wrist of the corpse bore the marks of the serpent's teeth, and the disfigured body showed that the man had been crushed by the constriction of the reptile round the head, neck, breast, and thigh."

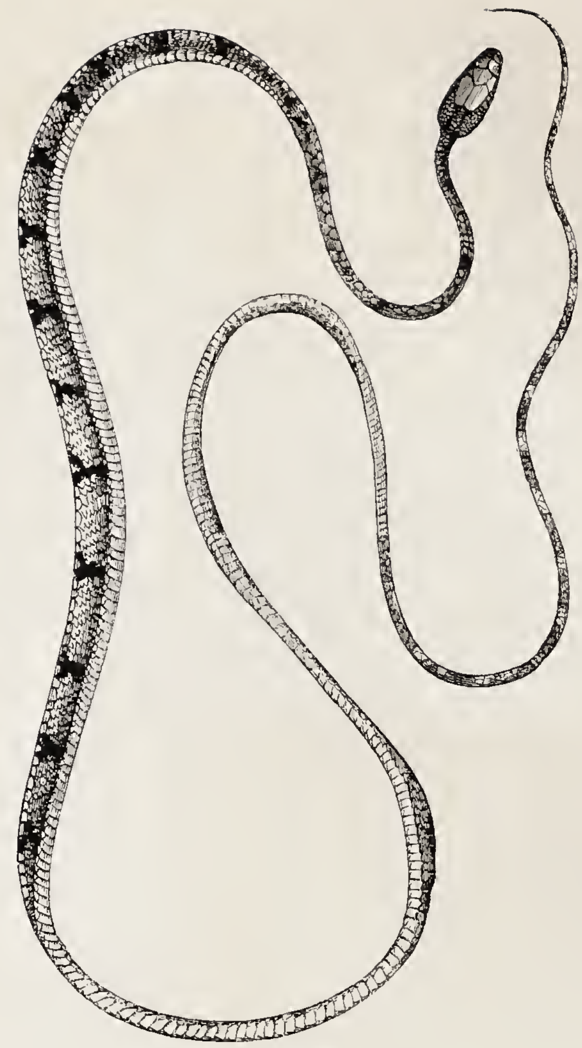
Mr. McLeod in his 'Voyage of H.M.S. Alceste,' after describing the mode in which a python on board, sixteen feet in length, crushed and gorged a goat, the distressing cries of which on being introduced into the serpent's cage, could not but excite compassion, goes on to say that during a captivity of some months at Whidah, in the kingdom of Dahomey, on the coast of Africa, he had opportunities of observing pythons of more than double that size, and which were capable of swallowing animals much larger than goats or sheep. "Governor Abson," he adds, "who had for thirty-seven years resided at Fort William (one of the African Company's settlements there), describes some desperate struggles which he has seen, or which had come to his knowledge, between the snakes and wild beasts, as well as the smaller cattle, in which the former were always victorious. A negro herdsman belonging to Mr. Abson (and who afterwards limped for many years about the fort) had been seized by one of these monsters by the thigh; but from his situation in a wood the serpent in attempting to throw himself round him, got entangled with a tree; and the man being thus preserved from a state of compression, which would instantly have rendered him quite powerless, had presence of mind enough to cut with a large knife which he carried about with him, deep gashes in the neck and throat of his antagonist, thereby killing him, and disengaging himself from his frightful situation. He never afterwards, however, recovered the use of that limb, which had sustained considerable injury from the fangs and mere force of his jaws."

Ludolph states that enormous snakes exist in Ethiopia; and Bosman informs us that entire men have been found in the gullet of serpents on the Gold coast. In the 'Oriental Annual' is the following narrative, explanatory of a well-known picture by Mr. W. Daniell:—"A few years before our visit to Calcutta," says the writer, "the captain of a country ship while passing the Sunderbunds sent a boat into one of the creeks to obtain some fresh fruits, which are cultivated by the few miserable inhabitants of this inhospitable region. Having reached the shore the crew moored the boat under a bank, and left one of their party to take care of her. During their absence the lascar who remained in charge of the boat, overcome by heat, lay down under the seats and fell asleep. Whilst he was in this happy state of unconsciousness an enormous boa (python) emerged from the jungle, reached the boat, had already coiled its huge body round the sleeper, and was in the very act of crushing him to death, when his companions fortunately returned at this auspicious moment, and attacking the monster, severed a portion of its tail, which so disabled it that it no longer retained the power of doing mischief. The snake was then easily despatched, and was found to measure, as stated, sixty-two feet and some inches in length." It is hardly probable that the snake had fairly entwined round the man, for the sudden compression of the chest, had the snake exerted its strength, would have been almost instantly fatal.

We need not enter into the painful and revolting details of the mode in which the goat was crushed and gorged on board the Alceste, the account of which is given by Mr. McLeod, and has been often transcribed; suffice it to say, that with astonishing velocity, like a flash which dazzles and is gone, the goat was rigidly encircled in the monster's knotted folds, and afterwards gradually swallowed; the appearance of the snake, with the throat swelled out as if about to burst, and the jaws dripping with saliva, being hideous and disgusting.

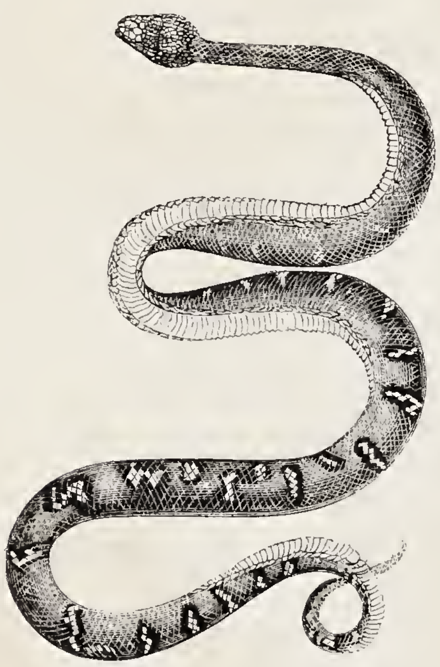
In March 1841, a singular circumstance occurred at the gardens of the Zoological Society, which at the same time caused no little surprise. A python eleven or twelve feet long, and one about nine feet long, was kept together in a well-secured cage; both had been fed one evening, the larger one with three guinea pigs and a rabbit; but, as it would appear, his appetite was unsatiated. The next morning when the keeper came to look into the cage, the smaller python was missing—its escape was impossible—and the question was what had become of it? The truth was evident—its larger companion had

2262.—Emperor Boa.

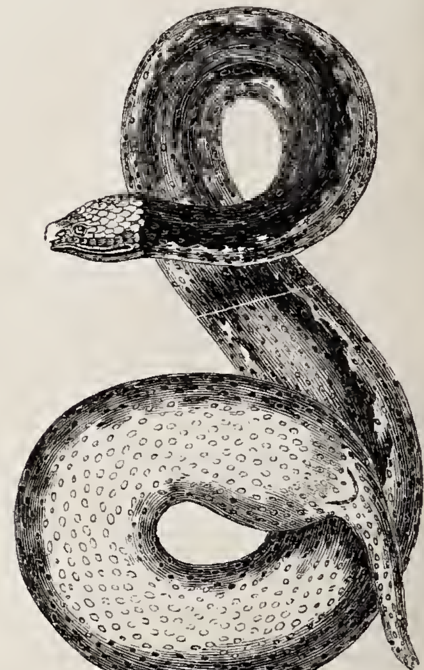


2255.—Dipsas.

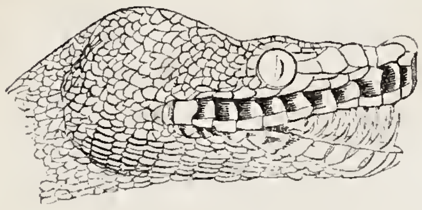
2253.—Anaconda.



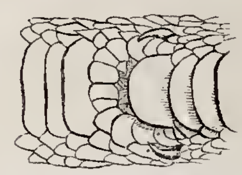
2264.—Bojobi.



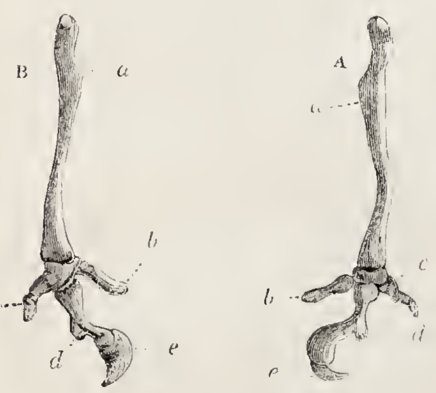
2257.—Oular Carron



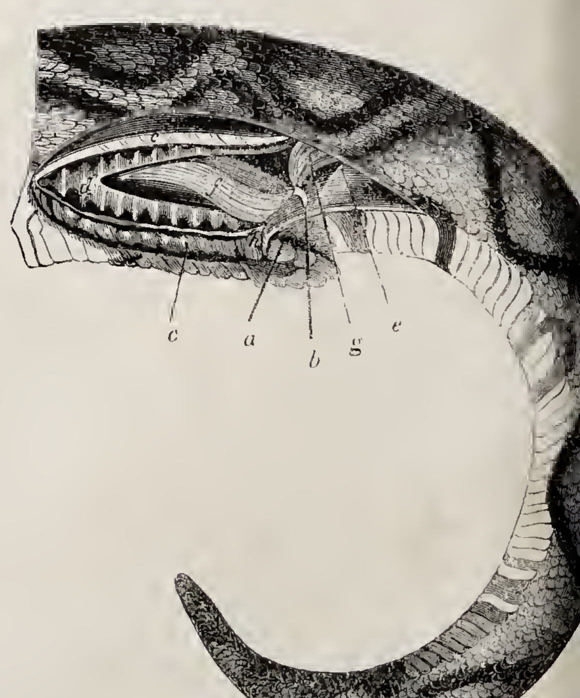
2258.—Head of Boa canina.



2259.



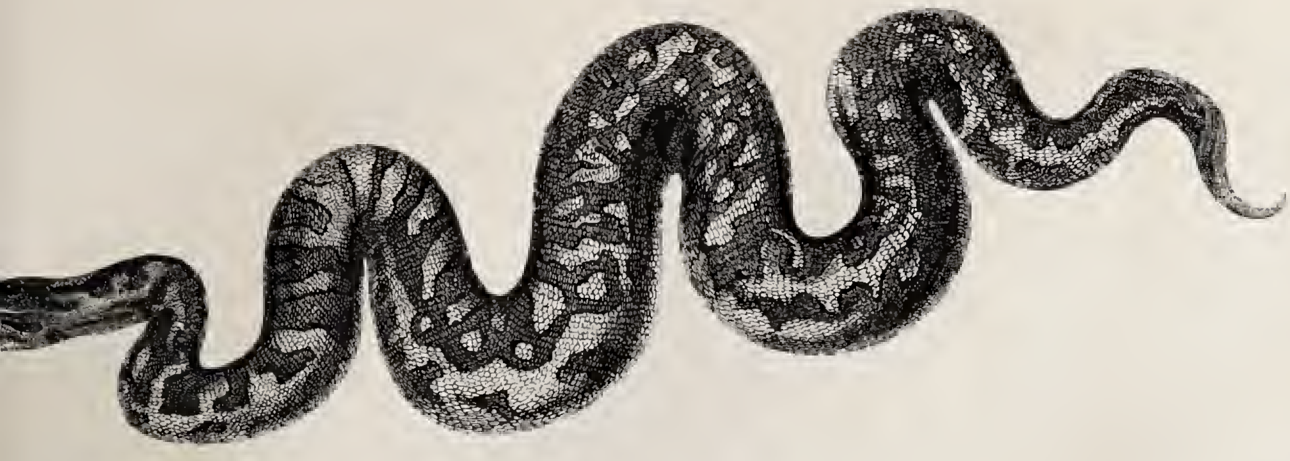
2260.—Spur of Boa.



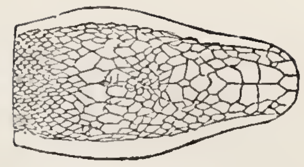
2256.—Cape Lycodon.

2254.—Boiga.

2261.—Tail of Boa.



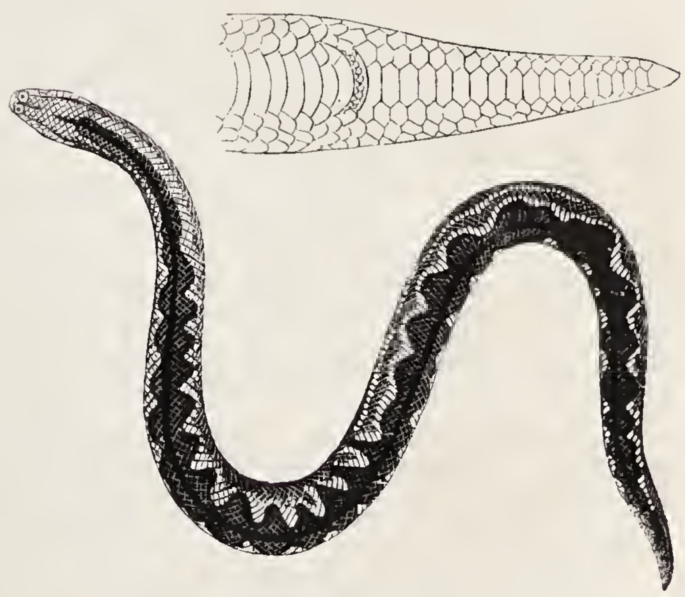
2268.—Port-Natal Python.



2269.

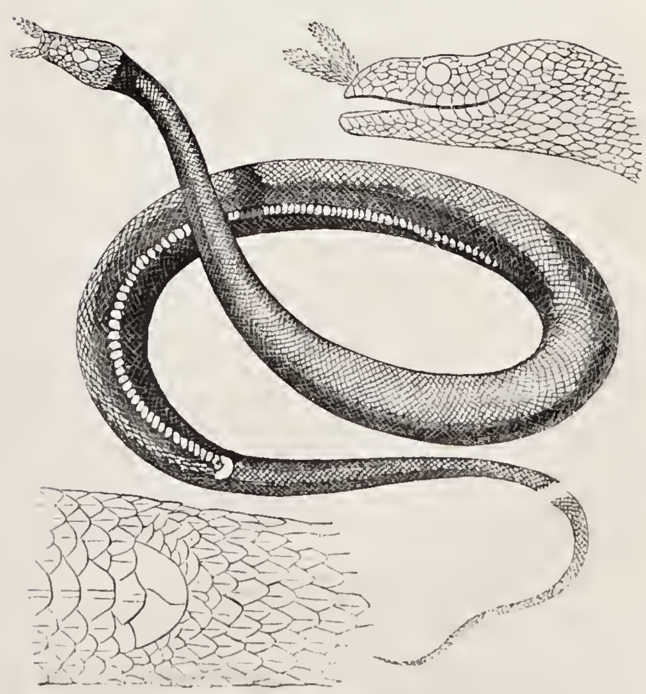
2265.—Aboma.

2267.—Boa Constrictor.



2270.—Bengal Eryx.

2266.—Tiger-Python.



2271.—Tentacled Herpeton.

swallowed it. There it lay torpid, and bloated to double its ordinary dimensions. How it accomplished the act is not known, but we may imagine a fearful struggle to have taken place, as wreathing round each other they battled for the mastery; unless, indeed, the victim was itself torpid, and incapable of resistance.

2266.—THE TIGER PYTHON

(*Python tigris*). This splendid species is a native of India and Java, and is often brought over to England for exhibition. It was, we believe, from one of this species that Mr. Cops, the keeper of the lion office, was in imminent danger, as narrated by Mr. Broderip. The animal was near shedding its skin, and consequently nearly blind, for the skin of the eye, which is shed with the rest of the slough, becomes then opaque, when Mr. Cops, wishing it to feed, held a fowl to its head. The snake darted at the bird, but missing it, seized the keeper by the left thumb, and coiled round his arm and neck in a moment. Mr. Cops, who was alone, did not lose his presence of mind, and immediately attempted to relieve himself of the powerful constriction by getting at the snake's head. But the serpent had so knotted himself on his own head, that Mr. Cops could not reach it, and had thrown himself on the floor in order to grapple with a better chance of success, when two other keepers coming in broke the teeth of the serpent, and with some difficulty relieved Mr. Cops from his perilous situation. Two broken teeth were extracted from the thumb, which soon healed, and no material inconvenience was the result of this frightful adventure.

Fig. 2267 represents one of these pythons in the act of darting upon a small animal.

2268.—THE PORT-NATAL PYTHON

(*Python natalensis*). This snake is a native of South Africa, where it was discovered by Dr. Andrew Smith, who observes, that either this species, or one very like it and of equal size, was formerly an inhabitant of the districts now within the Cape colony, and that the traditions of the older Hottentots abound with instances of its miraculous powers. At present, he says, it is not to be found within hundreds of miles of the boundaries of the colony, and few specimens have been obtained nearer than Port Natal. He informs us that it occasionally attains a very large size, and, according to the natives, individuals have been seen whose circumference was equal to that of the body of a stout man: Dr. Smith himself saw a skin which measured twenty-five feet, though a portion of the tail part was deficient. "It feeds," he continues "upon quadrupeds, and for some days after swallowing food, it remains in a torpid state, and may then be easily destroyed. The South Africans, however, seldom avail themselves of ridding themselves of a reptile they view with horror, as they believe that it has a certain influence over their destinies; and affirm that no person has ever been known to maltreat it without, sooner or later, paying for his audacity." Fig. 2269 represents the upper surface of the head.

It would appear from the same authority that a python common in India (P. bivittatus) is found also in Western Africa; and that specimens from the latter locality are in the museum at Fort Pitt, Chatham.

2270.—THE BENGAL ERYX

(*Eryx Bengalensis*). The genus Eryx was first separated from boa by Daudin; it differs in having a very short obtuse tail, and in wanting the hooks at the base; the ventral scuta are narrow; the head is short, and scarcely exceeds the neck, and is covered above with small scales. Of the habits of this species little is known. Fig. 2270 includes a delineation of the abdominal and subcaudal plates.

2271.—THE TENTACLED HERPETON

(*Herpeton tentaculatus*). Erpeton tentaculatus, Lacépède; Rhinopirus tentaculatus, Merrem.

In this remarkable snake, an example of the genus Herpeton, the muzzle is furnished with two soft appendages, covered with scales; the head is covered with large plates; the abdominal scuta are small; the tail is long and pointed, and covered beneath with the same kind of scales (squamæ) as above. There are no hooks or rudimentary limbs. Of the use of the two singular appendages to the muzzle we can give no account, nor are the peculiar habits of this snake understood. With the figure are delineations of the head, and under surface of the tail.

2272.—THE KAROO BOKADAM

(*Coluber Cerberus*, Daudin). Genus Cerberus of Cuvier.

Cuvier places the genus Cerberus near the pythons, observing that, as in those serpents, the whole of the head is covered with scales, the anterior portion only, including the eyes, being protected by plates (see Fig. 2273, the Head of Cerberus). There are no hooks, and the subcaudal plates are sometimes double, sometimes simple.

Russell, who describes this species in his work on Indian serpents, observes that the head, though somewhat broader than the neck, yet appears small in proportion to the trunk: a little convex above, compressed on the sides, and projecting into a short obtuse snout, on which the eyes and nostrils are situated. The snout is covered with small laminæ of various forms, the rest of the head with small suborbicular carinated scales. The mouth is not large; the jaws are nearly of equal length; the teeth close set, regular, small, reflex; a marginal and two palatal rows in the upper jaw. The eyes vertical, small, orbicular, protuberant; each situated in the centre of a remarkable circle of small triangular laminæ. The nostrils very small, vertical, near to each other, and close to the apex of the muzzle. The trunk is thick, round, covered with large carinated oval scales. Length three feet four inches. General colour dark grey above; the head almost black, under parts dusky yellow.

Dr. Russell adds, that his specimen, from which the figure is taken, was sent from Gangam in July 1788, and that he never saw one alive. He remarks that notwithstanding its suspicious appearance the want of poison organs proves that the snake is not formidable.

An allied species, Cerberus cinereus, Cantor, is described in the 'Proceeds. Zool. Soc.' 1839, p. 55. It is a native of Bengal, where it is termed by the inhabitants Jál Githéa.

From the innoxious serpents we may now pass to the section containing the venomous races. There is something peculiarly repulsive in the appearance of venomous serpents; their thick broad head, their sparkling eyes, and their wide jaws, give them a ferocious expression, from which we involuntarily recoil. They appear as if confident of their deadly weapons, and when irritated or opposed assume an attitude of defiance, and prepare to inflict the fatal stroke. All are ovoviviparous. If we examine the skull of one of these deadly reptiles we shall find it modified very differently from that of the nonvenomous races, on many important points. Let us take the skull of the Rattle-snake, as an example. See Fig. 2274.

In the first place the upper maxillary bones or jaws, which in the python and common snake, &c., we see long, though free, and armed with a row of teeth, are each reduced to a short rounded bone, in which the poison fang is implanted; this bone is moveable or rotatory, and is supported posteriorly by a long slender pedicle, the external pterygoid bone, also moveable, governed by certain muscles; hence it follows that when this slender bone is retracted, the small maxillary bone rotates backwards, and the poison fang is received into a fold of the gum fitted for its reception; but when the external pterygoid is pushed forward, the maxillary bone rotates anteriorly, and the poison fang is thrown forwards ready to inflict the wound. Behind this poison fang there are germs undeveloped, ready on its loss to occupy its place, at least after the lapse of a short period. Passing from the maxillary to the palatine bones, to which the external pterygoids are articulated, we see them furnished with a row of ordinary simple teeth.

The lower jaw is long and slender, and articulated to the skull by a long and slender tympanic and a slender mastoid bone, all movaeble, whence the gape of the jaws is very wide. The lower jaw is armed anteriorly with simple teeth.

With respect to the structure of the poison fangs, we must observe that they are so constructed as to enclose a tube or channel, leading from a large poison gland, and conveying the deadly fluid to the very bottom of the wound. This tube is not pierced through the substance of the fang, but is exterior to it, and formed by a fold of its edges, which are soldered together. This peculiarity is well described by Professor Owen, who observes that "a true idea of its structure may be formed by supposing the crown of a simple tooth, as that of a boa, to be pressed flat, and its edges to be then bent towards each other, and soldered together, so as to form a hollow cylinder open at both ends. The flattening of the fang, and its inflexion around the poison duct, commence immediately above the base, and the suture of the inflected margins runs along the anterior and convex side of the recurved fang: the poison canal is thus in front of the pulp cavity."

Such is an outline of the structural peculiarities in the jaws of the more typical poisonous snakes, as Vipera, Naja, Crotalus, Trigonocephalus. In others, however, there is a row of teeth more or less numerous, behind the poison fangs, and in the upper maxillary bones. In all the family of marine serpents, the poison fang is only the foremost of a row of fixed maxillary teeth; four or five in number on each side. Such is also the case in some of the terrestrial genera, as Bungarus, in which there are from three to five grooved teeth, behind the great fangs; and in Hamadryas, the huge poisonous tree-snakes of India, in which the same peculiarity occurs. Hence Cuvier divides the venomous serpents into such as have isolated poison fangs, and into such as have other maxillary teeth also.

Fig. 2275 represents the poison gland, its duct, and the fang of the Trigonocephalus: (*a, a*, the Poison Gland; *b*, the Duct; *c*, the Fang; the letter indicates the position of the slit from which the poison passes into the wound. "The poison glands," says Professor Owen, "occupy the sides of the posterior half of the head; each consists of a number of elongated narrow lobes, extending from the main duct, which runs along the lower border of the gland, upwards and slightly backwards; each lobe gives off lobules throughout its extent, thus presenting a pinnatified structure; and each lobule is subdivided into smaller secerning cæca, which constitute the ultimate structure of the gland. The whole gland is surrounded by a double aponeurotic capsule, of which the outermost and strongest layer is in connection with the muscles by whose contraction the several cæca and lobes of the gland are compressed and emptied of their secretion. This is then conveyed by the duct to the basal aperture of the poison canal of the fang. We may suppose, that as the lachrymal and salivary glands are most active during particular emotions, so the rage which stimulates the venom-snake to use its deadly weapon, must be accompanied with an increased secretion, and great distention of the poison glands; and as the action of the compressing muscles is contemporaneous with the blow by which the serpent inflicts its wound, the poison is at the same moment injected with force into the wound from the apical outlet of the perforated fang."

It would appear that one venomous serpent can kill another by the bite, at least if it be of a distinct species: for it seems that individuals of the same species may bite each other with impunity. We believe also, that if in its rage a serpent bites itself, no symptoms are produced. Russell says that Cobras bite each other without any consequence ascribable to the poison, but they kill other snakes.

The huge poisonous Hamadryas of India, often twelve feet in length, habitually preys upon other serpents, darting at them, and killing them by poison, after which it gorges them. The Naja of Southern Africa has been known to kill and swallow the poisonous puff-adder (Vipera arietans), and it is asserted that the rattle-snake will seize and kill the poisonous Moccasin snake, and afterwards swallow it.

The poison of serpents acts more or less quickly and decidedly, according to the species, the vigour of the individual, the quantity thrown into the wound, and the season of the year. Contrary to what Fontana and M. Schlegel assert (who says it is neither acid nor alkaline), the poison of these reptiles turns litmus paper red, invariably displaying acid properties. (See Cantor, 'Zool. Proceeds.' 1837, p. 75, note; and Harlan, 'Med. and Phys. Research.' p. 501, sq.)

It is a remarkable fact, that as far as hitherto tested, the poison of snakes may be swallowed with impunity, provided there be no abrasion of the skin of the lips, or any part of the mouth; hence when a person is bitten by one of the reptiles, the best way, if a cupping-glass be not at hand, or cannot be applied, is to suck the wound, as forcibly as possible. With this fact Celsus was well acquainted. His words are, "Those persons who are called Psylli, have not indeed any special knowledge, but boldness confirmed by habit; for the poison of a serpent is not injurious when tasted, but when instilled into a wound. Therefore, whoever, following the example of the Psyllus, will suck the wound, will be both safe himself, and save the sufferer. But this point must be fairly settled, that no ulcer be either in the gums, the palate, or any part of the mouth." With respect to the various specifics so confidently recommended, they are of no use. Ammonia used as an internal medicine after the poison is drained from the wound, and the free application of olive oil, appear to be the most efficacious; the great aim must be to keep up the energies of the system; to extract the poison, or neutralize if possible its active properties.

Fortunately only one poisonous snake, the bite of which is however seldom fatal, exists in our island, viz. the Viper.

2276, 2277.—THE VIPER

(*Pelias Berus*). Adder; Vipera vulgaris, Latr.; Vipera communis, Leach.

The characters of the head are seen at Fig. 2278.

The common viper is spread over Europe, and is tolerably frequent in many parts of England, giving preference to dry woods, sandy heaths, peat lands and sunny banks, and similar places. In Scotland it is more numerous than the common snake. In some parts of Yorkshire vipers are abundant, and

they are so in all the chalk counties. Vipers vary considerably in colour; hence we have the black viper, the blue-bellied viper, the red viper, the common viper, &c., which some naturalists have ventured to regard as distinct species—whereas the truth is they are mere varieties, as is now satisfactorily demonstrated.

Happily for us, this is our only venomous reptile; and, dreaded as it is, it is by no means so dangerous as reported. It never commences an attack, and turns to bite only when driven to self-defence or suddenly molested; nor is its bite necessarily fatal. We have ourselves known persons bit by vipers—one a relative; he was punctured on the thumb: the part swelled and inflamed, and the inflammation (with considerable pain and constitutional irritation) ascended the absorbents to the axillary glands; with a little care, however, in a few days every bad symptom was removed. We have, indeed, heard of cases in which death has resulted from a viper's bite, but we have never been able positively to authenticate an instance, though we are willing to admit that, as the effects are much more severe in some instances than others, persons of a highly excitable or feeble temperament may have sunk under the action of the poison, especially if the animal was in full vigour and activity when it inflicted the wound.

Small animals, as mice, rats, birds, &c., are immediately affected by the poison, and soon perish. The viper often attempts to swallow prey too large to pass down the œsophagus. Mr. Bell has in his possession a small viper from Poole Heath, in Dorsetshire, which was taken in a dying state, having forced down a mouse, which had caused the skin of the neck to burst in several places. Mr. J. C. Cox found a viper in the neighbourhood of Lausanne, which had swallowed a common lizard nearly as long as itself, and which had forced a hole through the side of the viper, one of its fore-legs protruding. ('Mag. Nat. Hist.,' 1838, p. 238.)

The viper is ovoviviparous, the young being excluded from the egg previously to parturition. So requisite is the heat of the sun for this development of the young, that the female viper may be often seen extended in the genial rays, basking with flattened body, and unwilling to remove from the spot on the approach of danger. The young vary in number from ten to twenty, and are alert and active from their birth.

We have often heard it asserted, though we have never been able to verify the statement, that the young vipers when alarmed hastily retire within the mouth of their parent, and lodge in the stomach or œsophagus till the danger is passed. To this circumstance Mr. Bell, in his work on British reptiles, makes no allusion. Mr. Blyth (See Loudon's 'Mag. Nat. Hist.,' 1837, p. 441) observes respecting it, "I have been informed of this by so many credible eye-witnesses, that I cannot hesitate in yielding implicit credence to the fact. One man particularly, on whose word I fully rely, tells me that he has himself seen as many as thirteen young vipers thus enter the mouth of their parent, which he afterwards killed, and opened for the purpose of counting them. The following extract shows that the habit is common to other venomous serpents, all of which are, I believe, without exception ovoviviparous. It is stated of the rattle-snake, in Hunter's 'Memoirs of a Captivity among the North American Indians,' that 'when alarmed, the young ones, which are eight or ten in number, retreat into the mouth of the parent, and reappear on its giving a contractile muscular token that the danger is passed.'" Gilbert White says, "Several intelligent folks assure me that they have seen the viper open her mouth to admit her helpless young down the throat on sudden surprises, just as a female opossum does her brood into the pouch upon the like emergencies; and yet the London viper-catchers insist on it to Mr. Barrington that no such thing ever happens." When evidence is thus contradictory, it is difficult to know what to believe. We have seen vipers oft, but we never saw the occurrence in question, nor do we know any naturalist who has himself seen it. Mr. Blyth, who devoted much time to the out-door study of our native animals, never witnessed it himself, though he believes it upon report. It has been well observed that much related concerning the habits of reptiles seems to be as confused as it is inexact. "Country-people, besides being inexact in their accounts (although their occupations afford them good and frequent opportunities for making observations), are seldom to be depended upon: they are not nice observers of that which does not immediately affect their concerns; and disgust, or fear, or indifference incapacitates them from taking accurate notice: and these feelings induce contradiction, confusion, and exaggeration. Viper-catchers may be better authorities, as from use they overcome the not unnatural repugnance to these animals; but in their case, accuracy depends entirely upon individual intelligence, and, except the reporters be unexceptionable, their statements ought to be cautiously received."

The viper hybernates, several entwining together in a deep hole, or other secure lurking-place, and passing the winter in a state of torpidity.

In many parts of England the viper is better known by the name of adder, anciently, says Mr. Bell, written nedre, and afterwards eddre; it is from the Anglo-Saxon nœdre, nether, lower—a far-fetched derivation, and we agree with Mr. J. Bladon that there is one much nearer at hand, viz. neidr, the ancient British and modern Welsh name for the reptile in question. In the plural form it is much more apparent, nadroedd, applied both to the viper and common snake.

We shall conclude our observations on the viper by alluding to two singular superstitions connected with this reptile—perhaps not yet altogether passed away. From the earliest times the flesh of the viper was celebrated (like that of the skink, a kind of lizard) in the cure of various diseases, and is praised by Pliny and Galen. The ancients generally served the animal, boiled, like fish; but in our country viper-broth was the preparation in request. In England these reptiles were caught by means of a stick with a fork or cleft at one end, for pinning the animal down, just behind the head: the man then seized the struggling reptile by the tail, and put it into a bag: and in this way the shops of the apothecaries were supplied.

Many persons have heard of the ovum anguinum of Pliny—the glein neidr of the ancient British—the adder-gem or adder-stone. These celebrated charms for curing various diseases are nothing more than antique blue, green, or striped glass beads of various sizes, and perforated. Pliny attributed their production to snakes convoluted together in summer, and notices the statement of the Druids with regard to their mystic production; and Mason, in his 'Caractacus,' gives this Druid's song:—

"From the grot of charms and spells,
Where our matron sister dwells,
Brennus, has thy holy hand
Safely brought the Druid wand,
And the potent Adder-stone,
Gender'd 'fore the autumnal moon?
When in undulating twine
The foaming snakes prolific join,
When they hiss, and when they bear
Their wondrous egg aloof in air;
Thence, before to earth it fall,
The Druid in his hallowed pall
Receives the prize,
And instant flies
Followed by the invenom'd brood,
Till he cross the crystal flood."

Pennant says, "Our modern Druidesses give much the same account of the ovum anguinum (Glein Neidr, as the Welsh call it; or the adder-gem) as the Roman philosopher does; but seem not to have so exalted an opinion of its powers, using it only to assist children in cutting their teeth, or to cure the hooping-cough, or drive away an ague." Some of these ancient beads are seen at Fig. 2279.

A species of viper, called El Effah (apparently identical with the Hebrew word "Ephah," translated viper), is described and figured in Jackson's 'Marocco,' as one of the most common and venomous of serpents in North Africa and South Western Asia. "It is about two feet long and as thick as a man's arm, beautifully spotted with yellow and brown, and sprinkled over with blackish specks. They have a wide mouth, by which they inhale a great quantity of air, and when inflated they eject it with such force, as to be heard to a considerable distance." He adds, that they abound in the desert of Suse, where their holes are extremely numerous. Capt. Riley, in his 'Authentic Narrative' (1817), describes their colours as beautiful, and says that Jackson's engraving is very correct.

Our Fig. 2280, copied from Jackson, represents this species, which is probably the Vipera Ægyptiaca of Latreille.

2281.—The Unadorned Viper

(*Vipera* [*Echidna*] *inornata*, Smith). In the subgenus Echidna, the top of the head is wholly covered with small imbricated scales.

The present species is a native of South Africa; but little, according to Dr. Smith, is known of its habits, excepting that, like the other species of the genus, it is indolent and heedless of the approach of man; indeed, he adds, the vipers, and one or two species of Elaps, are the only snakes of South Africa which permit themselves generally to be approached without evincing any apparent concern; the others manifest a disposition to act on the defensive, or fly. Even an unusual noise is sure to cause the retreat of the innocuous ones. The najas are always ready for fight, and when their haunts are invaded, advance upon the intruder with the head and anterior part of the body almost perpendicular, the neck expanded, and an expression sufficiently indicative of the malignant purpose they have in view. "To witness such a proceeding," he continues, "once fell to my own lot. Walking in the vicinity of Graham's Town, I happened to excite the attention of a Naja Hæmachates, which immediately raised its head, and warned me of my danger by the strength of its expiration; it then commenced an advance, and had I not retired, I should in all probability have suffered, provided I had not been fortunate enough to disable it; which probably would not have happened, considering that the species, in common with others of the same genus, is extremely active. Even though I retired, I was not satisfied that the danger was past, as the flight of this snake's enemy does not always put a stop to its advance when once commenced. An officer of the Cape Corps, upon whose authority the most implicit reliance was to be placed, informed me that he once was chased twice round his waggon by an individual of the same species, and the pursuit might have been prolonged had not a Hottentot disabled the enraged reptile by a blow from a long stick."

The unadorned viper is about thirteen inches in length: its general colour above is yellowish brown; under parts dusky yellow sparingly sprinkled with brownish dots.

2282.—The South African Cerastes

(*Cerastes caudalis*, Smith). The genus Cerastes is distinguished among the vipers, by a little pointed horn rising from the upper margin of each eye.

One species is a native of Egypt, Lybia, &c., but the present was discovered in South Africa by Dr. A. Smith. In these snakes, the head is broad and very distinct from the neck, the body thick, the tail taper. Fig. 2283 represents the Head and Tail of Cerastes caudalis.

This species inhabits dry sandy districts, and manifests the ordinary indolence of character common to the vipers; on which account, says Dr. Smith, "they are more dreaded by the native of South Africa than even snakes possessed of more virulent poison, but disposed to action on the approach of danger. According to good testimony, this species will continue for days together in one position, and as it never seeks to avoid danger, however imminent, its presence is rarely discovered unless when trampled upon, and the offending party is wounded by its fangs. Though inactive, it is by no means so when injured; its movements are then performed with activity; and when once it seizes the obnoxious object, it retains its hold with great determination, and some considerable exertion is often required to detach it. The same may be said of most of the vipers, in which respect they differ materially from naia." This species is about fourteen inches long.

The upper parts are yellowish red variously spotted and marked with orange brown, and other tints. The under parts are pale rose red, with a pearly lustre.

2284, 2285.—The Egyptian Cerastes

(*Cerastes:—Vipera cerastes*). This species, as well as the Cobra or Hajé, was well known to the Egyptians of antiquity, and figures of it occur abundantly in their temples: it is this species beyond doubt of which Herodotus speaks in the following passage, "There are about Thebes sacred serpents entirely innoxious to man; they are of diminutive size, and have two horns sprouting from the crown of the head; when they die they are buried in the temple of Jupiter, to whom they are said to be sacred." Herodotus was in error in saying that these snakes are innoxious; he had perhaps only examined tame ones, from which the poison fangs had been carefully extracted.

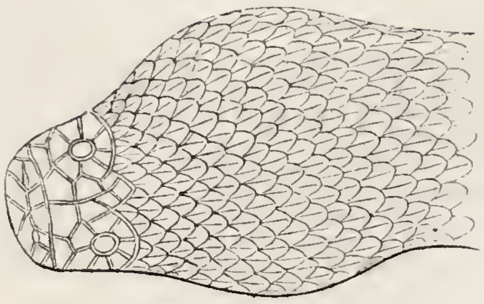
In its manners, this species precisely resembles the preceding: it inhabits the sandy desert, where in ruts or depressions it will lie quietly for days, luxuriating in the heat of the sun; and as its colours assimilate with those of the surface on which it reposes, there is danger of treading accidentally upon it, at the risk of a wound.

It appears to have considerable powers of enduring hunger and thirst; probably it never drinks: its food consists of insects, small reptiles, mice, &c.

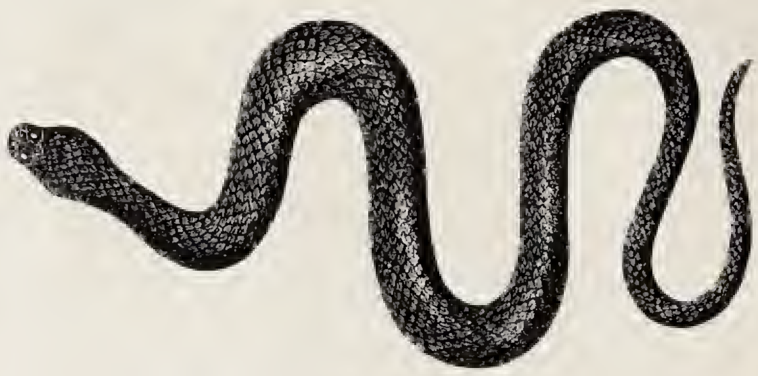
Bruce states that he kept two of these snakes in a glass jar for two years, without giving them any food; they did not appear to become torpid in winter, and cast their slough at the close of April.

Speaking of the partiality of these animals for heat, he says that though the sun was burning-hot all day, yet "when we made a fire at night by digging a hole and burning wood to charcoal in it for dressing our victuals, it was seldom that we had fewer than half a dozen of these vipers, which burned themselves to death by approaching the embers." "The poison," he adds, "is very copious for so small a creature; it is fully as large as a drop of laudanum dropped from a phial by a careful hand. I compelled one to scratch eighteen pigeons upon the thigh, and all died in nearly the same interval of time."

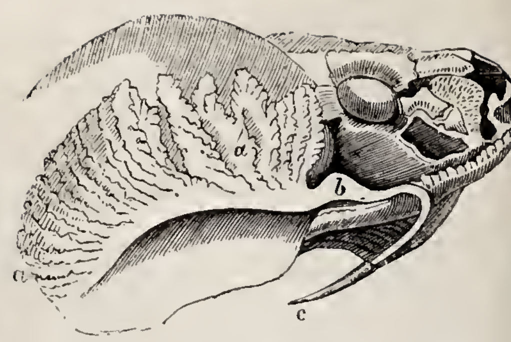
"The cerastes moves with great rapidity and in all directions, forwards, backwards, and sideways. When it inclines to surprise any one who is too far from it, it creeps with its side toward the person



2273.—Head of Cerberus.



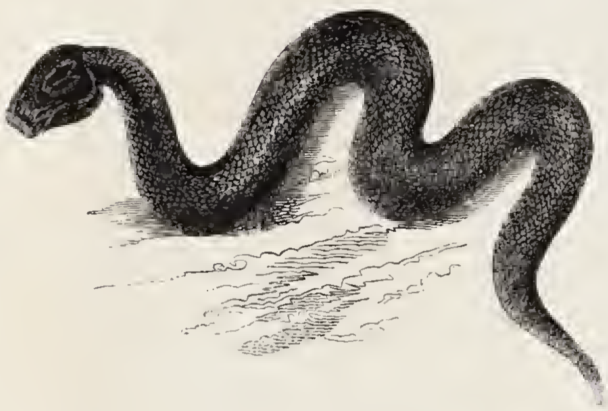
2272.—Karoo Bokadam.



2275.—Tooth and Poison-Gland of Trigonocephalus.

2278.—Head of Viper.

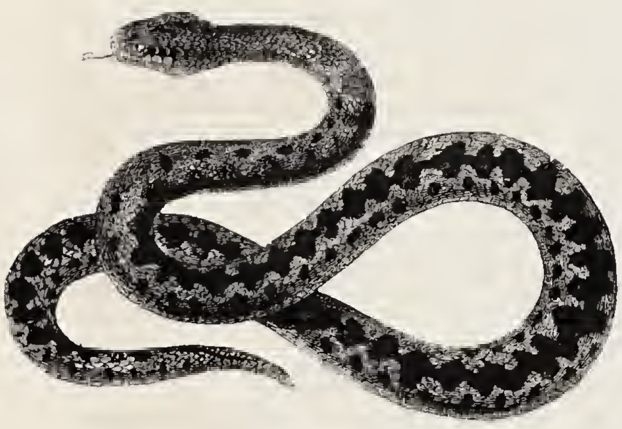
2279.—Adder-Stones.



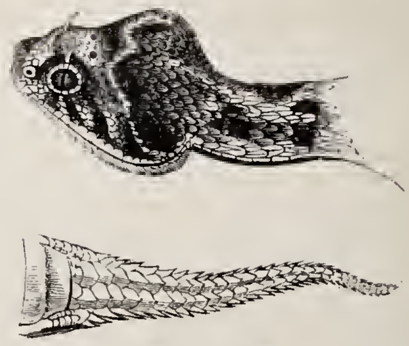
2281.—Unadorned Viper.

2277.—Viper and Young.

2274.—Skull of Rattlesnake.



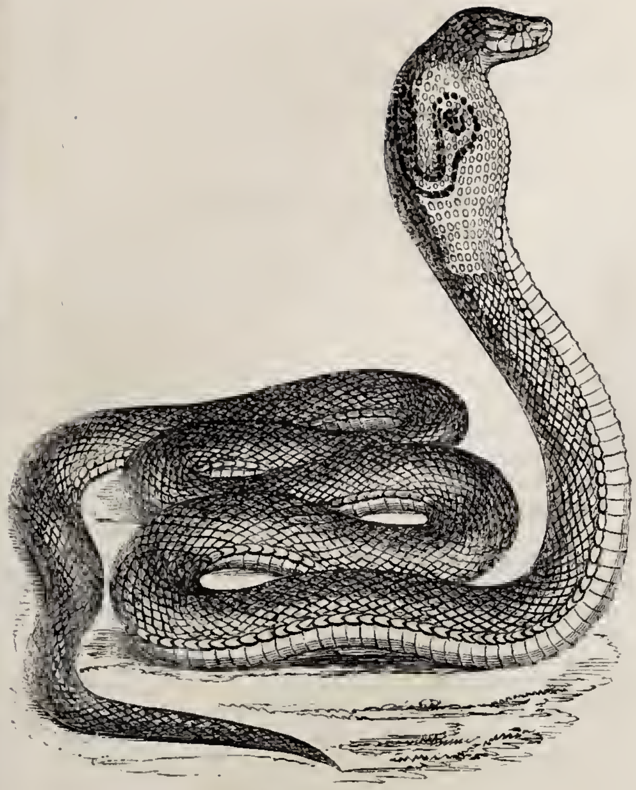
2276.—Viper.



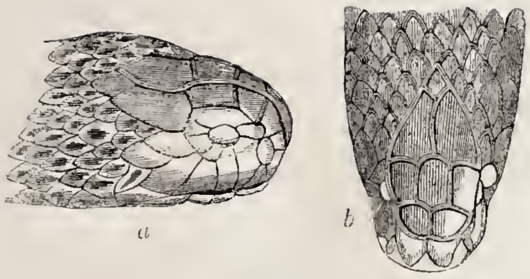
2283.—Head and Tail of Cerastes.

2280.—"El Effah" Viper.

2282.—South African Cerastes.

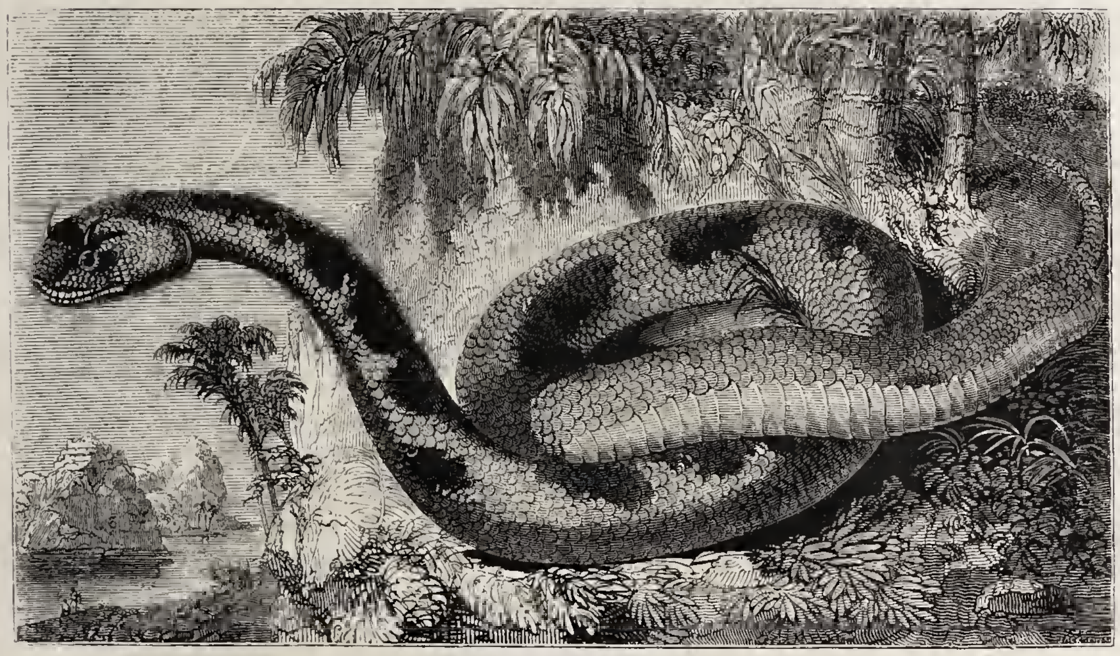


2290.—Indian Naja.



2286.—Head of Naja.

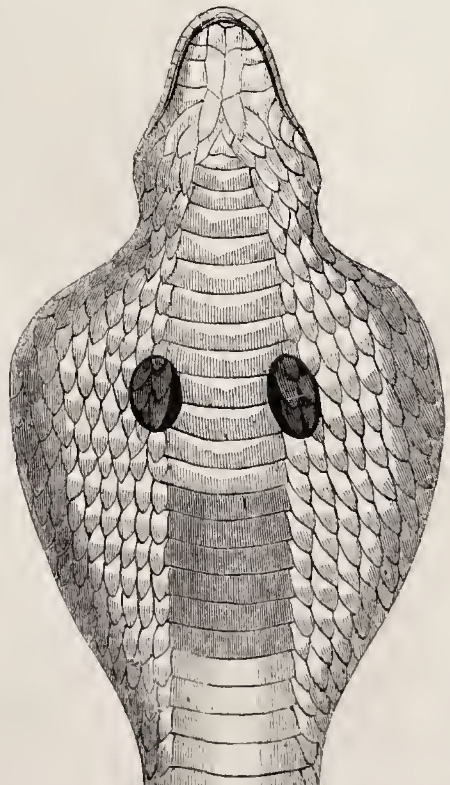
2291.—Indian Naja.



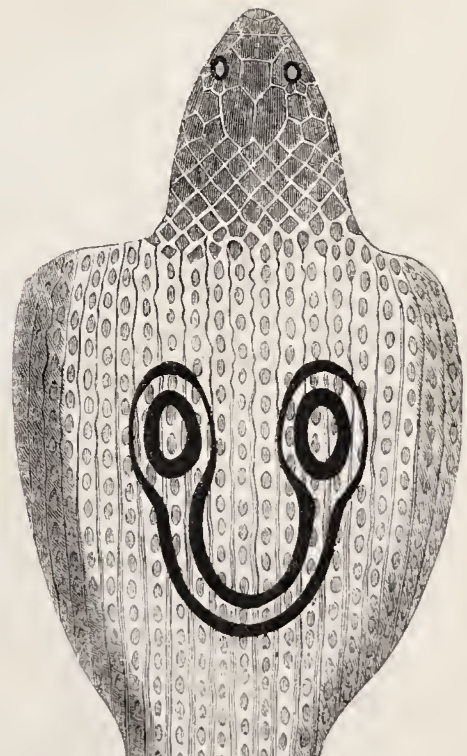
2284.—Egyptian Cerastes.

2285.—Egyptian Cerastes.

2289.—Hood of Naja.



2287.—Hood of Naja.



2288.—Hood of Naja.

and its head averted, till judging its distance, it turns round, springs upon him, and fastens upon the part next to it; for it is not true that the cerastes does not leap or spring. I saw one of them at Cairo crawl up the side of a box in which there were many, and there lie still as if hiding himself, till one of the people who brought them to us came near him; and though in a very disadvantageous posture, sticking as it were perpendicular to the side of the box, it leaped near the distance of three feet, and fastened between the man's finger and thumb, so as to bring the blood. The fellow showed no signs either of pain or fear; and we kept him with us for full four hours without his applying any sort of remedy, or seeming inclined to do so. To make myself assured that the reptile was in its perfect state, I made the man hold it by the neck, so as to force open its mouth and lacerate the thigh of a pelican, a bird as big as a swan. The bird died in about thirteen minutes, though it was apparently affected in about fifty seconds." As a proof of the power which the snake-charmers have of handling poisonous snakes with impunity, the same traveller says, "I have seen at Cairo a man who came from above the Catacombs, where the pits of the mummy-birds are, who has taken a cerastes with his naked hand from a number of others at the bottom of a tub, put it upon his bare head, and tie it about his neck like a necklace. After which it has been applied to a hen, and bit it, which has died in a few minutes: and to complete the experiment, the man has taken it by the neck, and beginning at the tail has eaten it as one would do a carrot or stock of celery, without any seeming repugnance." Bruce's idea is that certain Arab tribes have the knowledge of some roots, the chewing of which, combined with a washing of the body with an infusion of the leaves in water, exempts them from the effects of the poison of these reptiles. But with regard to the Black people of Sennaar he suspects them to be naturally proof against the poison. His opinions on these points are unworthy serious consideration; and we cannot help thinking with Cloquet, that he was credulous and imposed upon by the dexterity of jugglers. Those who have seen fire-eaters exhibit their tricks can easily imagine that a similar deception might be practised, substituting a serpent for burning materials; and as to the experiments, the substitution of a perfect for a fangless snake, and vice versa, by a dexterous hand, is about upon a par with the thimblerig game. Besides his details are anything but precise, nor do we wonder at it; for when speaking about the poison glands he says, "I confess the danger attending the dissection of these parts made me so cautious that any observations I should make upon them would be the less to be depended upon." From this we may judge of his coolness when the living reptiles were creeping loose about him, or writhing in the hands of jugglers.

We now advance to a far more formidable group of serpents, the deadly Cobras, Najas or Naias, which have been celebrated from the earliest times, and which are respectively distributed to Africa and India.

In the genus Naja or Naia, the head is covered on the top and sides with plates; and the skin of the neck is extremely dilatable, or capable of being expanded to such a degree as to form a thin hood, the scales during the expansion being thrown far apart, from the stretching of the skin. When irritated these snakes elevate the head and anterior portion of the body, expand their hood, hiss loudly, and with sparkling eyes advance resolutely towards their assailant; in this attitude their appearance is very beautiful, and, were there no cause for alarm, might be contemplated with pleasure. An encounter with an enraged naja is, indeed, no trifling affair, for though seldom more than five or six feet long, the reptile is bold and powerful, and springs on its foe with great velocity; and, as its bite is mortal, its destruction the next moment cannot repair the mischief. In dealing with such creatures discretion is the better part of courage. Fig. 2286 represents the Head of Naja; *a*, the side view; *b*, as seen from above: Fig. 2287, view of the upper side of the Hood expanded, with the head on the same line with the body: Fig. 2288, a view of the under side of the same: Fig. 2289, the Head seen from behind, when the anterior portion of the excited serpent is in an erect posture.

In the naja tripudians the hood is impressed behind with a mark somewhat resembling the central portion of a pair of spectacles reversed: it usually consists of a double reversed horseshoe line of black or brown, with the two ends dilated so as to enclose an oval space, in the centre of which is a ring or spot of black.

2290, 2291.—THE COMMON INDIAN NAJA

(*Naja tripudians*). Cobra de Capello* of the Asiatic Portuguese; Serpent à lunettes of the French; Spectacle Snake of the English; Nag and Chinta Nagoo of the natives.

This formidable snake attains to five, or even six feet in length; Captain Percival, indeed, says that specimens occur in Ceylon as long as fifteen feet; but these specimens, we believe, will be found to belong to the genus Hamadryas, which we shall hereafter notice, and of which, the species being hooded, go under the indiscriminate name of "Cobras:" they attain to very large dimensions, and are dreadfully venomous, and much feared.

We have already spoken of the manner in which the naja expands its hood and advances to the combat; and well, as Captain Percival says, is it that he gives the signal, as his motions afterwards are too rapid to be avoided; and he adds, "I have more than once been an eyewitness to instances where the fatal bite of this snake was escaped merely by the object of his vengeance timely observing his preparations. One remarkable quality of these dangerous serpents is their fondness for music; even when newly caught they seem to listen with pleasure to the notes, and even to writhe themselves into attitudes. The Indian jugglers improve greatly on this instinct, and after taming them by degrees, instruct them to keep time to their flageolet."

The colour of these snakes is subject to some variation, and in Ceylon, according to Dr. Davy, those of a light colour are called high-caste snakes, those of a dark colour low-caste. "The natives," he says, "in general rather venerate this snake than dread it. They conceive that it belongs to another world,* and that when it appears in this it is merely as a visitor; they imagine that it possesses great power, that it is somewhat akin to the gods, and greatly superior to man. In consequence they superstitiously refrain from killing it, and always avoid it, if possible. Even when they find one in their house, they will not kill it, but, putting it into a bag, throw it into water. They believe that this snake has a good and generous disposition, and that it will do no harm to man unless provoked." Dr. Davy gives a pleasing picture of the irritations and soothings with which the snake-charmers excite and allay the temper of this serpent, and records several instances of the operation of the poison. In one case a young cock was bitten in the thigh, and gradually sank, and perished in convulsions in about seventeen minutes. The first symptoms consisted in the respiration becoming hurried and laborious, to which succeeded a comatose state; the breathing then became scarcely perceptible, when four or five convulsive fits came on, each weaker than the other, the last proving fatal.

A distinct species, found in Calcutta, Bombay, and Assam, and termed by Dr. Cantor the Masked Naja (Naja larvata), is described in the 'Zool. Proceeds.' 1839, p. 32. It is of a brownish colour, with numerous faint transverse stripes; the hood is marked with a white ring, not unlike the form of a mask, behind which there are from three to five white rings; the anterior part of the lower surface is marked with alternate white and bluish black rings; the posterior part is iridescent glaucous.

A young specimen of this snake was living in 1829 in the Society's Gardens, Regent's Park. The artificial temperature, 62° Fahr., in which it was kept appeared to agree with it very well. Dr. Cantor observes that, in one respect, it offered in its habits a striking difference from those of the najas generally in captivity, for, as he was informed by the keeper, it feeds occasionally upon living frogs and earth-worms, and that it drinks milk; while those in Dr. Russell's possession, and also in his own, in India, when deprived of liberty invariably refused to take any kind of food. This must be taken with some exceptions, for Col. Briggs states that those kept by the priests in the temples are pampered with milk and sugar, and will feed out of the hand as tamely as any domestic animal.

2292, 2293, 2294.—THE EGYPTIAN COBRA OR ASP.

(*Naja Hajé*). El Hajé, or Hajé Nascher of the modern Arabs.

This formidable snake was well known to the ancients, and Cuvier observes that "its habit of elevating itself when approached led the ancient Egyptians to believe that it was the guardian of the plains which it inhabited, and they adopted it as the protecting deity of the world; it is this snake which they sculptured on all the portals of their temples, on two sides of a globe." This species is incontestibly the asp or aspic of Egypt, or of Cleopatra, who chose it as the instrument of her death,—"the worm of Nilus there that kills and pains not," in order to defeat the intentions of Cæsar.

Among the Egyptians this snake was one of the marks of regal dignity, and is seen on the forepart of the tiara of almost all the Egyptian statues of deities and kings.

Pliny gives the following account of this species, "The neck of the asp," he says, "is capable of distention, and the only remedy against its bite is amputation of the wounded part. This animal, otherwise so much to be dreaded, has a sentiment or kind of affection truly wonderful; it never lives alone, the male and female being constantly found together, and if one happens to be killed the other seeks with the utmost fury to avenge its death. It knows and selects the destroyer from among crowds, and can only be deprived of its revenge by the most speedy flight, or the intervention of some rapid river." He adds that the lateral position of its eyes prevents it from seeing straight before it, and that consequently it is often trodden under foot before it is aware of its danger. This latter circumstance by no means proves its incapacity for seeing before it; in fact its sight is as quick as its actions are prompt and rapid. Old walls, ruins amidst woods, and similar places are its usual haunts.

It would appear, from Dr. A. Smith, that this species is a native of Southern Africa, as well as Egypt, Lybia, &c. In his African Zoology he figures three varieties of the Hajé, as well as the snake in its young state, with the synonyms Echidna flava, Merrem; Naja nigra, Smith; Geel Copell, Bruin Copell, and Spuugh-Slang of the Dutch Cape Colonists. Fig. 2295 represents the Hajé in its young state, and 2296 the variety called Spuugh-Slang.

He describes the majority of the South African specimens as either entirely yellow or purplish brown, though a considerable number occur in which both these colours exist in the same individual: the depth of the colour varies considerably in different specimens, particularly in the yellow ones, in which every shade between straw yellow and clear purplish brown may be observed. The general colour of the young is pale straw yellow, with two brownish red collars on the throat; the extremities of each of which are visible upon the neck above, and the extremities of the lower collar are generally connected by a narrow bar of the same colour across the hood; the eyes are light chestnut brown. Dr. A. Smith further remarks, that if this reptile be specifically distinct, he had not been able, after a close comparison, to discover the distinctive characteristics; and that the differences of colour among those collected in Egypt are quite as great as among the South African specimens.

With respect to the variety called spuugh-slang (spitting snake), which is of a livid blackish brown, and which is more rare than the others, he observes that it has acquired its name from its supposed power of ejecting its poison to a distance. All the Cobra de Capellos, he remarks, distil poison from the points of their fangs when they are much irritated, and are able to eject a portion of it beyond the mouth by a forcible expiration, but he is not disposed to admit that any greater power is possessed by the spuugh-slang. The contrary, however, is asserted both by the Colonists and natives:—"Both of these affirm that the snake in question is able to cast its poison to a distance of several feet, especially if the wind be blowing so as to favour its object; and that it often projects it into the eyes of unwelcome intruders, and thereby occasions a degree of inflammation which not uncommonly terminates in loss of sight. In the Cape Colony the varieties of the Cobra de Capello are all regarded as highly dangerous, and many severe if not fatal consequences are the results of their bite. They are all savage and bold, and when assailed they generally resist rather than fly, and they not unfrequently act upon the offensive. They climb trees with great facility and often take to the water out of choice. In the liquid element their progress is rather slow, and during their residence in it the head is always kept raised above the surface. Whenever they are excited or irritated they, like the common species of India, inflate the loose skin of the neck, and extend it

* This name is now given indifferently to all the hooded snakes.

* Dr. Davy, in his chapter on the Cingalese System of the Universe, has the following passage:—"The Naga-bhawené, that lies under Asoora bhawené, is also 10,000 leagues in circumference. It is a hollow sphere, without mountains or hills, lakes or rivers, and entirely destitute of vegetation, with the exception of a single tree, called Parasattoo, that answers for all others, bearing not only an immense variety of flowers and fruits, but everything else that is desirable. The Naga-bhawené is the abode of a numerous race of snakes, similar in kind to the hooded snake, and of great size, beauty, and power, capable of passing from one part of the world to another, and shining like gods so that, though they have no light but that which emanates from their own bodies, they enjoy perpetual day infinitely brighter than ours. In their former lives on earth they were persons of remarkable purity and goodness, almost deserving of becoming gods; but their high virtues were sullied by some vice, particularly that of malice, to which they owe their present forms. Though snakes, they are Bhoodists, and are in possession of a relic and worship in temples. They reside in well-furnished houses, and eat and drink, and enjoy society. By merely wishing, they immediately have any article of food they want, and whatever it may be it always appears in the form of a frog. They are under a regal government, and are distributed into castes, like the Cingalese. Their king, Mahakilla naga rajaya, is in every respect superior to the rest; it was with his assistance that the gods and Asooras churned the milky sea; he wound himself round a rock, and they, pulling at his two extremities, set the mass in motion and accomplished their work. Were these snakes disposed, they could destroy the whole of the inhabitants of the earth by a single blast of their poisonous breath; but they are naturally mild and benevolent, and do harm only when provoked. In consequence they are rather venerated than dreaded; and it is on this account that the common hooded snake is so much respected."

laterally so as to exhibit an appearance as if the neck was edged on each side with a thin semicircular appendage. They feed upon small quadrupeds, birds, and eggs, and in search of the latter they ascend trees to rob nests."

We have already alluded to a large hooded serpent, the Hamadryas (Hamadryas ophiophagus), a native of India, described by Dr. Cantor ('Zool. Proceeds.' 1838, p. 73 et sq.) This snake having a few maxillary teeth behind the poison glands, appears to form a link between the genera Naja and Bungarus, the latter of which it resembles in its dentition. Its Hindostanee name is Sunkr Choar.—"According to the natives," says Dr. Cantor, "the Hamadryas feeds chiefly upon other serpents; in one I dissected I found remains of a good-sized Monitor (varanus); which fact may account for its arboreal habits, as I have in Bengal, along the banks of the rivers, observed numbers of these large lizards among the branches of trees watching for birds.

"The power of abstaining from food, generally speaking so characteristic of the serpents, is but in comparatively small degree possessed by this species; the most protracted starvation amounts to a period of about one month, while the Vipera elegans, the Naja tripudians, and the Bungarus annularis, have, without inconvenience, been confined in cages without any food for more than ten months. Two specimens of the Hamadryas in my possession were regularly fed by giving them a serpent, no matter whether venomous or not, every fortnight. As soon as this food is brought near, the serpent begins to hiss loudly, and expanding the hood rises two or three feet, and retaining this attitude as if to take a sure aim, watching the movements of the prey, darts upon it in the same manner as the Naja tripudians does. When the victim is killed by poison, and by degrees swallowed, the act is followed by a lethargic state, lasting for about twelve hours.

"The Hamadryas, like the greater number of Indian serpents, evinces a great partiality to water; with the exception of the tree-serpents (Leptophina, Bell), they all not only drink, but also moisten the tongue, which, as this organ is not situated immediately in the cavity of the mouth, become in the serpents two different acts. Specimens of this serpent in my possession changed the skin every third or fourth month, a process which takes place in all the Indian serpents several times during the year. The Hamadryas is very fierce, and is always ready not only to attack but to pursue when opposed; while the Cophias, the Vipera, the Naja, and the Bungarus, merely defend themselves, which done, they always retreat, provided no further provocation is offered. The natives of India assert, that individuals are found upwards of twelve feet in length, a statement probably not exaggerated, as I have myself seen specimens from eight to ten feet in length, and from six to eight inches in circumference. I have often heard it asserted, that 'Cobras' (which name is naturally enough given to every hooded serpent) have been met with of an enormous size, but I strongly doubt their belonging to the genus Naja: among a considerable number which have come under my observation, I never saw any exceeding five to six feet in length, while the common size is about four feet. Some time before I discovered the Hamadryas, I was favoured by J. W. Grant, Esq., of the Hon. Company's Civil Service, with an interesting description of a gigantic hooded serpent he had observed in the upper provinces, and which, he remarked, was not a Naja. By inspection this gentleman denied the Hamadryas to be identical with the above-mentioned.

"The natives describe another hooded serpent, which is said to attain a much larger size than the Hamadryas, and which, to conclude from the vernacular name, 'Mony Choar,' is perhaps another nearly allied species.

"The fresh poison of the Hamadryas is a pellucid, tasteless fluid, in consistence like a thin solution of gum arabic in water; it reddens slightly litmus paper, which is also the case with the fresh poison of the Cophias viridis, Vipera elegans, Naja tripudians, Bungarus annularis, and Bung. cœruleus: when kept for some time it acts much stronger upon litmus, but after being kept it loses considerably, if not entirely, its deleterious effects.

"From a series of experiments upon living animals, the effects of this poison come nearest to those produced by that of the Naja tripudians, although it appears to act less quickly. The shortest period within which this poison proved fatal to a fowl, was fourteen minutes; whilst a dog expired in two hours eighteen minutes after being bitten. It should however be observed, that the experiments were made during the cold season of the year."

From our digression on the Hamadryas, we turn to a singular circumstance connected with the history both of the North African and Indian Cobras, and which has much engaged the attention of European travellers; we allude to their fascination by music, and the influence exerted upon them by a race or caste of professed snake-charmers, who appear from time immemorial in the East to have exercised their art upon them, and exhibited various performances.

We find allusions to serpent-charming in the Scriptures. Jeremiah writes:—"For behold, I will send serpents, cockatrices among you, which will not be charmed," ch. viii. 17. Again in the Psalms: "Their poison is like the poison of a serpent; they are like the deaf adder that stoppeth her ear; which will not hearken to the voice of charmers, charming never so wisely." Ps. lviii. 4, 5.

The charming or incantation of serpents is so strange, that many have utterly denied the fact, while others have asserted it to be a deception. Our own conviction is that serpents are extremely susceptible of impressions from musical notes, or modulations, under the influence of which they wreathe their bodies, from feelings of pleasure, while to these graceful contortions and undulating movements, the charmer, who plays on a pipe, or some simple instrument, skilfully adapts the time. That snakes are influenced by musical sounds we might quote various authorities to prove; it was in fact known to the ancients. "Cerberus Orpheo lenivit sibila cantu." Pliny and Seneca both affirm that serpents can be allured from their retreats by music; and among the moderns, who contend for the same, may be mentioned Chardin Greaves, Dr. Shaw Bruce, Sir W. Jones, Chateaubriant, &c. The latter indeed, in his 'Beauties of Christianity,' gives an interesting account of the effects upon a rattlesnake of modulations played on the flute by a Canadian, who at last, like Orpheus, led the fascinated reptile out of the camp, following him as he moved onwards; to the astonishment both of the Europeans and natives, who unanimously agreed that the creature's life should be spared; though in evident anger it had intruded into their encampment. "A learned native of this country [India]," says Sir W. Jones, "told me that he had frequently seen the most venomous and malignant snakes leave their holes, upon hearing notes from a flute, which as he supposed gave them peculiar delight:" 'Asiat. Res. vol. iii. p. 315. Mr. Gogerly, a missionary, confirms this statement. He observes that some persons who were incredulous on the subject, after taking the most careful precautions against any trick or artifice being played, sent a charmer into the garden to prove his powers: "The man began to play upon his pipe, and proceeding from one part of the garden to another, for some minutes stopped at a part of the wall much injured by age, and intimated that a serpent was within. He then played quicker, and his notes were louder, when almost immediately a large Cobra de Capello put forth its hooded head, and the man ran fearlessly to the spot, seized it by the throat and drew it forth. He then showed the poison fangs, and beat them out; afterwards it was taken to the room where his baskets were left, and deposited amongst the rest." Abundance of similar instances are on record; and we may here add that M. Schomberg, speaking of a pretty little lizard in the West Indies (Anolius bullaris), states, that "they are often caught by boys, who take advantage of their fondness for musical sounds, arresting their attention, and then throwing a little noose over their head," as they perch in a listening attitude on the branches of trees; 'Linn. Trans.' vol. xvii. p. 560. We have then here the key to the whole mystery. The exhibition of serpents is itself attended with deception, for the poison fangs are always carefully extracted; and hence are the wounds which the charmers subject themselves to, of comparatively little consequence. It should be observed, however, that long practice has given these men an intimate knowledge of the habits of these reptiles; hence it need not surprise us that they easily discover where they lurk, a point which has been often put to the rigid test. Mr. Lane imagines that it is by the smell that they discover the presence of these reptiles; but we are inclined to suppose that it is by the ear. As the man plays his pipe he regards attentively the most likely spots, and intently listens; his practised ear catches the slightest rustle of the serpent, as excited it turns or moves in its hole, its subdued hiss, or its quickened breathing; but the spectators, engaged in attending to the man, hear and see nothing but him, and are too much interested to endeavour to find the snake by the exercise of their own faculties. No doubt these men, in order to magnify themselves, arrogate more power than they are really entitled to, and throw an air of professional mystery over their operations, and hence many believe that all is assumed, and the whole a trick. Mr. Johnson, in his 'Indian Field Sports,' leans to this opinion; he says, "The professed snake-catchers in India are a low caste of Hindoos, wonderfully clever in catching snakes, and in practising the art of legerdemain: they pretend to draw them from their holes by a song, and by an instrument somewhat like the Irish bagpipe, on which they play a plaintive tune. The truth is, all this is done to deceive. If ever a snake comes out of a hole at the sound of their music, you may be certain that it is a tame one, trained to it, deprived of its venomous teeth, and put there for the purpose; and this you may prove, as I have often done, by killing the snake and examining it, by which you will exasperate the man exceedingly." No doubt they often act thus; but this does not prove that they cannot draw wild snakes from their retreats; indeed the contrary is notorious; Mr. Johnson is perhaps not aware of the effects of musical sounds, not only upon snakes, but upon other animals:—

> "Rude Heiskar's seals through surges dark,
> Will long pursue the minstrel's bark."

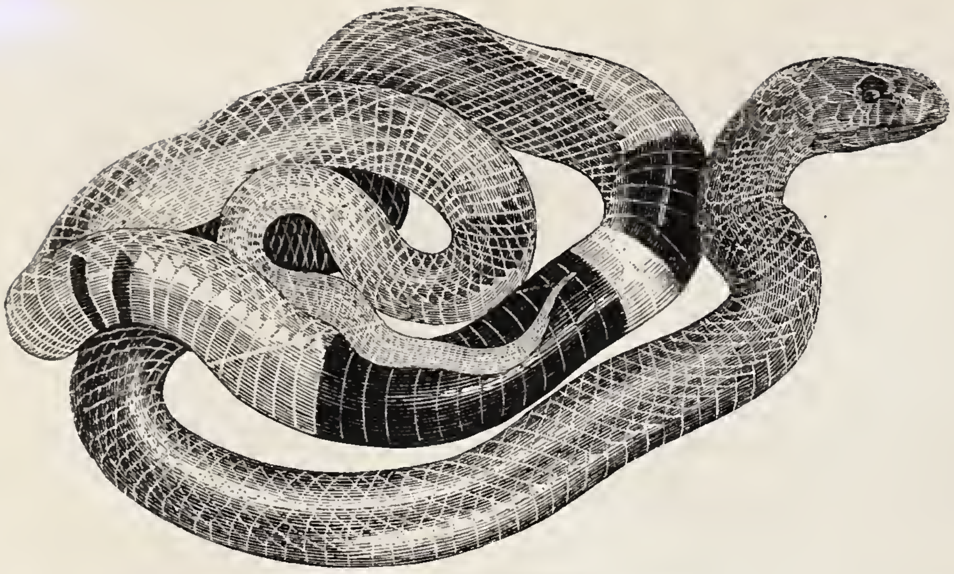
But besides seals, rats and mice are attracted by music, as we can testify, and deer and sheep. Music affects also dogs and cats, sometimes, as it would seem, distressingly; and if our memory serve us, we have somewhere read a detailed account of the influence of certain notes or modulations upon the ferocious animals of the menagerie. The subject requires a series of detailed observations, when perhaps some singular facts would be elicited. Of the modern snake-charmers, the Psylli were the ancient prototypes. They were a people of Cyrenaica, a country in Africa abounding in reptiles; supposed to be endowed with the natural power of charming serpents, from whose bite they were exempt: Pliny supposed that some odour of their persons, which the serpents abhorred, protected them, and Lucan says the same.

The latter, in his poem of 'Pharsalia,' describes the method they adopted to drive away these reptiles from the environs of the Roman camp, marching around it, chaunting mystic songs; and, what was more effectual, keeping up fires of different kinds of wood around the encampment during the whole of the night. If a soldier happened to be bitten they raised "the magic lay," and rubbed the parts around with saliva, to prevent, as they said, the poison from spreading, while they used their arts to extract it; and when suspicious symptoms arose they sucked the venom from the wound. We have already alluded to the opinions of Celsus respecting the Psylli.

Figs. 2297, 2298, and 2299 represent the modern Snake-charmers of Egypt and India exercising their art, and allowing the snakes to entwine around them. They carry about with them these reptiles in covered baskets, and, taking out eight or ten, cast them on the ground. The animals immediately begin to make off in different directions. "The snake-charmer," says Mr. Gogerly, "applies his pipe to his mouth, and sends forth a few of his peculiar notes, and all the serpents stop as though enchanted; they then turn towards the musician, and approaching him within two feet, raise their heads from the ground, and bending backwards and forwards keep time with the tune. When he ceases playing they drop their heads and remain quiet on the ground." He adds that there is another and inferior class of serpent-charmers, who are Bengalese, of the lowest caste. They do not use the pipe, but merely beat with their fingers a small drum held in one hand. Sometimes these men tease and irritate the snakes until they become infuriated and fasten on their naked arms, which they occasionally suffer to be bitten till covered with blood. Other serpent-charmers, again, merely allow large serpents to twine about their bodies, as if to show their perfect subjection, and the power with which they are gifted—

> "To dally with the crested worm,
> To stroke his azure neck, or to receive
> The lambent homage of his arrowy tongue."

Others, again, while in the serpent's coils, will allow themselves to be dreadfully bitten, till, from repeated wounds, and the torture they endure, they become swollen and in a really dangerous condition, notwithstanding the poison fangs have been removed. Such exhibitions are revolting, and, besides, by no means destitute of danger, as is proved by the statement of Mr. Johnson, who informs us that on one occasion, when a man was exhibiting a tame dancing cobra before a large party, a boy, the son of the exhibitor, and about sixteen years of age, teased the animal to make it bite him; this, indeed, it did, and to some purpose, for in an hour afterwards he died of the bite. The father of the boy was astonished, and protested his death could not be the result of the bite—that the snake had no venomous teeth—and that he and the boy had often been bitten by it before without any bad effects. On examining the snake it was found that the former fangs were replaced by new ones, then not far out of the jaw, but sufficiently so to produce the fatal effects that ensued. The old man said he had never heard of such a circumstance before. We should, however, be inclined to suspect that such

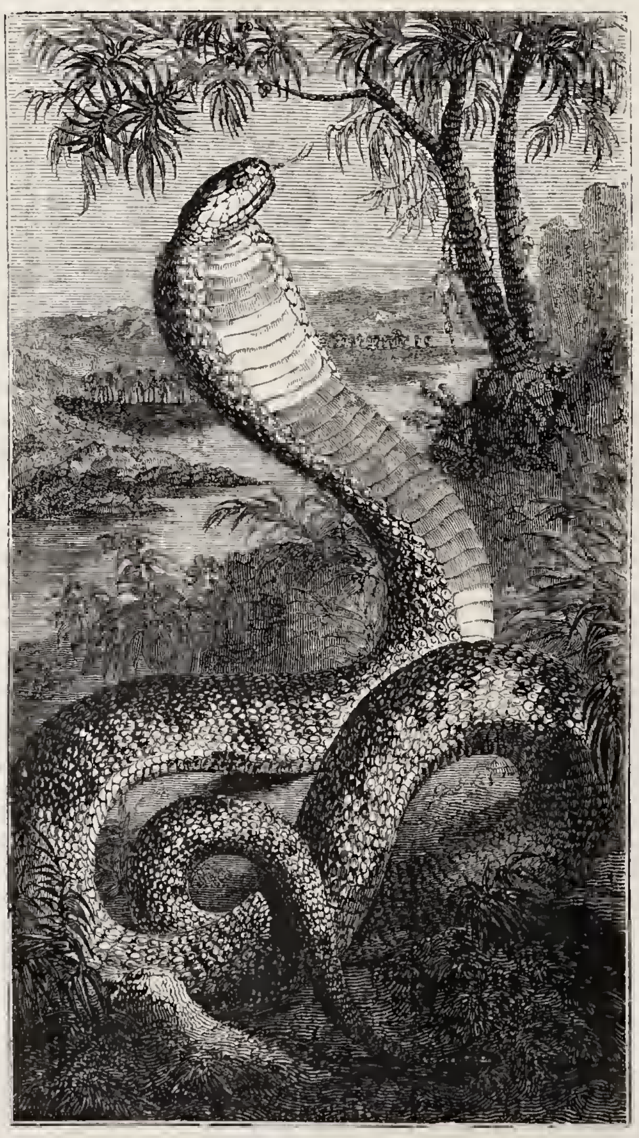


2292.—Egyptian Cobra or Asp.

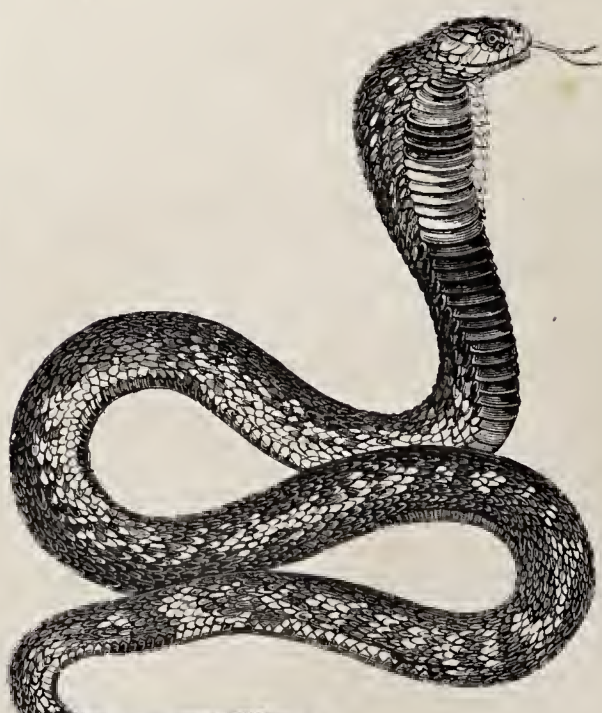
2296.—Spuugh-Slang.

2297.—Indian Jugglers and Snakes.

2295.—Naja Haje. Young.



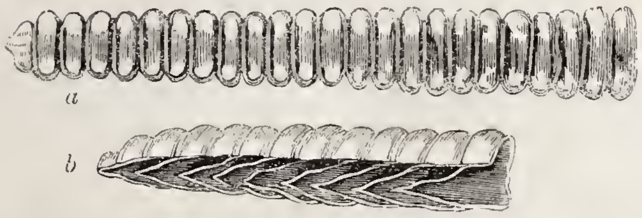
2294.—Egyptian Cobra.



2293.—Egyptian Cobra.

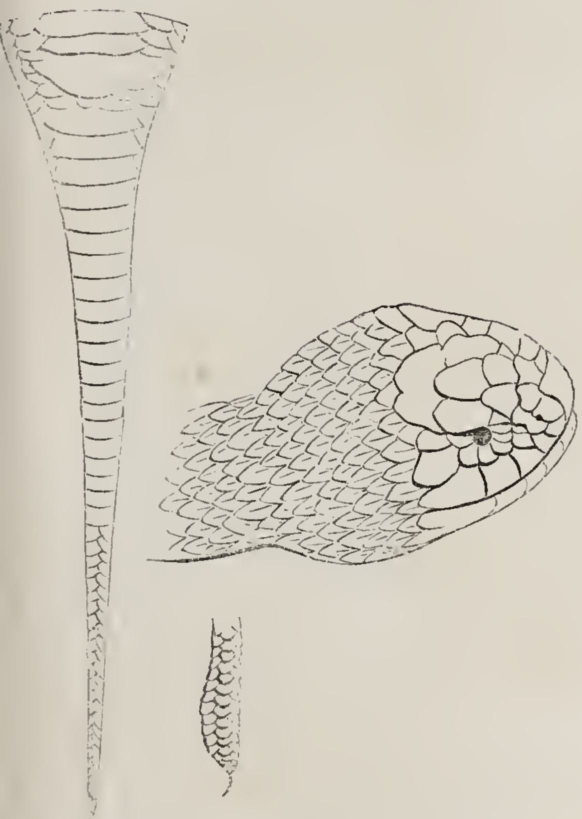
2304.—Rattlesnake.

2302.—Tail of Horned Acanthophis.



2305.—Tail of Rattlesnake.

2306.—Rattlesnake and Opossum.



2300.—Head and Tail of Brown's Acanthophis.

2298.—Serpent-Charmers.

2303.—Lesson's Acanthophis.

2299.—Serpent Charmers.

2301.—Horned Acanthophis.

accidents were not uncommon, though perhaps not generally known.

Serpents do not always "obey the voice of the charmer." Roberts mentions the instance of a man who came to a gentleman's house to exhibit tame snakes; and on being told that a cobra was in a cage in the house, was asked if he could charm it; on his replying in the affirmative the serpent was released from the cage, and, no doubt, in a state of high irritation. The man began his incantations and repeated his charms, but the snake darted at him, fastened upon his arm, and before night he was a corpse.

Among the snakes to be dreaded for their boldness and venom, may be noticed the lance-headed viper, of the islands of Martinico, St. Lucia, and we believe also of the Brazilian continent. It is the Vipère fer-de-lance of the French (Trigonocephalus lanceolatus, Oppel.).

This species attains to six, seven, and even, as it is said, eight or nine feet in length; and is remarkable for its activity. When about to make an attack, it throws itself into spiral coils, and then launches itself with the velocity of an arrow on its enemy. It greatly abounds in the sugar-cane plantations, and as the negroes are much exposed to its bite, many perish from time to time, from the effects of its poison. It is not, however, confined to sugar-cane plantations; it haunts woods, marshes, the luxuriant borders of rivers, and occurs even on the sterile mountains. M. Moreau de Jonnès and his companions, on their ascent to the crater at the pinnacle of a mountain, more than five thousand feet high, which overhangs the town of St. Pierre, in Martinico, encountered one of these snakes, at the summit, from which, as they were completely exhausted by their exertions, they were in great danger. Indeed, it was only eight days previously to their ascent, that a fisherman, while shooting his canoe over the volcanic pebbles of the shore at the base of that very mountain, had been attacked by one of these snakes; it rushed at him from its concealment among loose basaltic masses, and inflicted a wound which, notwithstanding all endeavours to save his life, proved fatal.

In the woods these reptiles mount to the tops of the highest trees, in quest of birds and their young, and often lie coiled in the snug nests of the previous tenants, which latter they have devoured. They lurk also in the holes of trees, and under the decomposing masses of herbage in close thickets, or among the parasitic plants which soon overgrow the mouldering logs of timber in the forest. Should a person incautiously approach the lair of one of these snakes, it will dart forth, and pursue the fugitive by a series of rapid leaps; and even when in the trees, it has been known to spring at a passer-by. Tenements in the country, and the embowered cottages of the negroes, are often invaded by this pest, and poultry-yards and pigeon-houses are subject to its visitations. It is not unfrequently brought into the towns among green fodder and vegetable productions, and numbers are constantly found to enter within the outworks of Fort Bourbon in Martinico. and Fort Luzerne in St. Lucia, during their nightly excursions, where they are dispatched as quickly as possible. Lizards, birds, and rats, but especially the latter, constitute the food of this serpent; after swallowing its prey, it is said to exhale a disgusting odour, yet the negroes, who are not very fastidious, eat its flesh, which is not unpleasant.

Nearly related to this snake is the formidable Bushmaster (Lachesis rhombeata) of Guiana, Brazil, &c. It is exceedingly venomous, and attains to the length of eight or nine feet. There are double scuta beneath the tail, which terminates in a short horny point; when surprised or irritated this reptile vibrates its tail, and produces a rustling noise by striking it against the dry grass or the brushwood; but not, as in the rattlesnake, by means of a special piece of oscillating mechanism. From this habit, however, Linnæus associated it with the rattlesnakes, under the name of Crotalus mutus. It is an intermediate form between those snakes and the viperine family.

We may now proceed to a genus, in which, mostly at least, the tail is terminated by a spiniform scale, but the plates beneath the tail, excepting a few of the last, are single. We allude to the genus Acanthophis, which appears to be restricted to Australia.

The following extracts from Mr. G. Bennett's interesting work, entitled 'Wanderings in New South Wales,' may not be unacceptable. "Snakes," he says, "are numerous in various parts of the colony. Those known among the colonists as the Black and Brown Snakes are found about the banks of rivers or in swampy situations. The natives, who, however, are not the best authorities (we query this), say that the bite is not deadly, but causes the person bitten to feel sick and sleepy for a short time, which passes off without being followed by any ill effects, even if no remedy be applied." These snakes measure about four feet in length, and readily take to the water. They feed upon frogs, lizards, &c. "There is," he continues, "another dangerous snake called Yellow Snake by the colonists, and Jaruk by the Yas natives. It attains to a very large size, and has the reputation of being very venomous; the bite (unless the piece be immediately cut out) producing almost immediate death.

"The most deadly snake in appearance, and I believe also in effect, is one of hideous aspect, called by the colonists Death Adder, and by the Yas natives Tammen, from having a small curved process at the end of the tail, bearing some resemblance to a sting; and the reptile is considered by popular rumour (but erroneously) to inflict a deadly sting with it."

"This hideous reptile (evidently an acanthophis) is thick in proportion to its length. The eye is vivid yellow with a black longitudinal pupil; the colour of the body is difficult to be described; being a complication of dull tints, with narrow blackish bands, shaded off into the hues which prevail upon the back; the under parts are slightly tinged with red. The head is broad, thick, and flattened. The specimen I examined measured two feet two inches in length, and five inches in circumference. A dog that was bitten by one died in less than an hour."

The snakes of this genus Acanthophis are dull and inanimated; they feed upon insects, lizards, and small mammalia.

2300.—BROWN'S ACANTHOPHIS

(*Acanthophis Brownii*). Our pictorial specimens of the Head and Tail of this hideous reptile suffice to convey a clear idea of the generic characters. According to Mr. P. Cunningham, this is the most venomous snake of New South Wales, and is, we suspect, identical with the Death Adder, described by Mr. G. Bennett.

Mr. Cunningham relates a remarkable fact, proving both the tenacity of life which these snakes possess, and the virulence of the poison. Two individuals, a male and female, were discovered by the dogs of a sportsman; the male was killed, but the female escaped into the hole; upwards of ten minutes afterwards, one of the dogs, in hunting about where the snake had been killed, was bitten in the foot by the head which had been cut off, and shortly after died in the most dreadful convulsions. The male is dark brown, the female of a light orange colour.

2301.—THE HORNED ACANTHOPHIS

(*Acanthophis cerastinus*). This species, which was first described by Merrem, is named Cerastinus from the similarity which, at first sight, it bears to the Cerastes, in its short thick body, large flat head, and eyes surrounded by prominent scales. The pointed spur with which the tail terminates is sharp, compressed, and slightly bent upwards. (Fig. 2302.)

2303.—LESSON'S ACANTHOPHIS

(*Acanthophis Tortor*). This species is described by Lesson in the 'Zoologie de la Coquille,' and is considered by him as identical with the A. Brownii of Dr. Leach. This, however, is evidently not the case, for in the first place the tail of Lesson's species is not tipped with a spine, and in the second place its colouring is perfectly different. It is elegantly tinted; a black velvety blue is spread over the upper part of the body; rose-colour deepened to red runs along each side from the jaws to the base of the tail. Pale yellow tinges the under surface of the body, but a brown circle occupies the centre of each abdominal plate; the head and tail are uniformly blue-black. Length about three feet. Lesson describes two poison fangs on each side, as small and sharp. Letter *a* represents the Head, which, it will be perceived, is very different from that of A. Brownii.

2304.—THE RATTLESNAKE

(*Crotalus durissus*). Crotalus horridus, Cuv.

Several species of Rattlesnake are known to naturalists, as the Boiquira or Diamond Rattlesnake of Mexico, Guiana, and Brazil (Crotalus horridus); the Common or Banded Rattlesnake of the United States (Crotalus durissus); and the Small Rattlesnake (Caudisona miliaris, Fitzin.). We may here observe that the terms *horridus* and *durissus* have been very loosely applied to the two former species by naturalists. Cuvier assigns the term *horridus* to the species found in the United States, and *durissus* to that of Guiana. In his 'North American Reptiles,' Dr. Harlan reverses the titles, and we adopt his application of them.

The rattlesnakes are all natives of America; the head is covered with scales, similar to those of the upper surface, excepting in the genus Caudisona, where it is protected by plates; there is a small depression behind each nostril; the tail is furnished with an appendage commonly termed its rattle; it consists of a number of thin horny cells, of a pyramidal figure, with a protuberant marginal ring; they are fitted into one another as far as this ring; that is, the pyramidal portion of one is received into the hollow of that succeeding, its apex reaching as far as the ring of the third, and so on,—hence when all together, only the protuberant margin of each is seen. The articulation of these distinct portions being very loose, they rustle against each other when smartly vibrated, and produce a distinct whirring noise that may be heard at some distance. The structure of the rattle is well expressed at Fig. 2305; *a* shows a rattle of twenty-four joints; *b*, the section of a rattle, showing the form of the distinct portions, and the mode in which they are fitted into each other. The number of the joints composing the rattle increase, to a certain period at least, with each moult of slough, and the basal bell is the last formed. When irritated or alarmed, the rattlesnake vibrates this appendage, and gives timely warning, for it is slow to strike, and never voluntarily attacks man, unless trodden upon or molested. It is, indeed, mostly glad to escape, retiring with tail erect and rapidly vibrating. These reptiles, when irritated, exhale a disgusting odour; it is said, however, that the peccary will destroy and devour them; though not, as we should suppose, without often experiencing the effects of their venomous fangs. Horses and dogs, however, avoid them.

"I have often," says M. Bosc, "amused myself by trying to force my horse and dog to approach one of these animals, but they would sooner have allowed themselves to be knocked down on the spot than come near them." It would seem from Kalm that horses and oxen perish from the bite of a rattlesnake sooner than dogs or men, yet dogs seldom survive. Captain Hall exposed some of these animals to the bite of a rattlesnake measuring four feet in length; the first struck with its deadly fangs expired in fifteen minutes, the second lingered in great agony for two hours before death ended its sufferings, and the third only began to feel the effects of the poison after an interval of three hours; four days afterwards the same snake bit a dog which died in thirty seconds, and another dog which died in four minutes.

Well is it then that such terrible reptiles are slow in their movements, indolent in their habits, and ready to give warning by their rattle of their presence! They are fond of lying coiled up in sunny spots, with the rattle elevated in the centre, and ready to be vibrated, when the animal sees an intruder, without moving any other part of the body. When exasperated, the rattlesnake continuously vibrates the tail; the head is flattened, the throat and cheeks are distended, the jaws open, the venom-fangs are displayed, the tongue quivers, and the body alternately swells and sinks with rage, like a pair of bellows; should its enemy now approach, the blow will be instantaneously struck; if, however, he retire, the reptile will unfold its coils, and creep away into the brushwood, as if unwilling to continue the strife.

Occasionally these snakes attain to very great dimensions. Catesby says, "The largest I ever saw was one about eight feet in length, weighing between eight and nine pounds. This monster was gliding into the house of Colonel Blake of Carolina, and had certainly taken his abode there undiscovered, had not the domestic animals alarmed the family with their repeated outcries; the hogs, dogs, and poultry united in their hatred to him, showing the greatest consternation, by erecting their bristles and feathers; and expressing their wrath and indignation, surrounded him, but carefully kept their distance, while he, regardless of their threats, glided slowly along." The same writer, speaking of the herbs used as antidotes to the bite, by the Indians, adds, "Having, by travelling much with Indians, had frequent opportunities of seeing the direful effects of the bite of those snakes, it always seemed and was apparent to me that the good effects, usually attributed to these their remedies, are owing more to the force of nature or the bite of a small snake in a muscular part. The person thus bit I have known to survive for many hours, without any assistance, but where a rattlesnake with full force penetrates with his deadly fangs, and pricks a vein or artery, inevitable death ensues, and that, as I have often seen, in less than two minutes. The Indians know their destiny the minute they are bit, and when they perceive it mortal apply no remedy, concluding all efforts are vain; but if the bite happen in a fleshy part, they immediately cut it out to stop the current of the poison. I could heartily wish that oil of olives applied to the wound might have as good success against the venom of these snakes as it hath been found in England to have had against the poison of the adder."

It is in the hottest part of the year only, accord-

ing to Mr. Pence of Philadelphia, that the poison of this reptile is the most dangerous. "Its bite," he says, "from the moment it emerges from its retreat till August, does not necessarily produce fatal effects. It has been remarked, and the observation has not escaped the Indians, that from the month of August to the time when about to retire to its winter quarters, the period in which it takes the most food, it becomes terrible, and its bite is mortal."

"We know that serpents in general retire on the approach of winter, according to the nature of the ground, and the temperature of the places they tenant, either under large stones, or into holes which other animals have burrowed. The Boigeura gives preference to places in the vicinity of water. We have dug up many of their holes on the borders of the river Maurice. They were all tortuous, and led to a sort of chamber distant from the entrance six or eight feet, and there we have found them in balls, and twined together. Our guide led us, on one occasion, into a marshy place, covered with a prodigious quantity of the sphagnum palustre, a kind of moss of which the stems are from six to twelve inches high. Having removed some of this moss, of which the top was frozen (the frost being so severe that it penetrated the naked ground to the depth of twelve or fourteen inches), we perceived many rattlesnakes slowly creeping among the roots of the trees, immediately beneath the moss, and on an oozy ground over which flowed running water not affected by the frost. Here I would make a passing remark, that this fact may be turned to account by persons employed in agriculture or gardening: this moss might be employed for the preservation of delicate plants liable to be killed by the severity of winter."

Numerous experiments prove that the rattlesnake eats indifferently all kinds of dead birds he meets with, and that he employs no supernatural means to seize his victims. He does not, however, eat frogs, to which the black snake (Coluber Constrictor) is so partial.

We may add that the rattlesnake never climbs trees, but waits on the ground for its prey, on which it darts when within the proper distance.

Mr. Pence says that the rattlesnake employs no supernatural means to seize his victims—and he speaks sensibly. Who, however, has not heard of the fascinating powers of this snake? The process is thus detailed by Catesby:—"The charming, as it is commonly called, or attractive power which this snake is said to have of drawing to it animals, and devouring them, is generally believed in America; as for my own part I never saw the action, but a great many from whom I have had it related all agree in the manner of the process; which is that that the animals, particularly birds and squirrels (which principally are their prey), no sooner spy the snake than they skip from spray to spray, hovering and approaching gradually nearer their enemy, regardless of any other danger, but with distracted gestures and outcries descend from the top of the loftiest trees to the mouth of the snake, who openeth his jaws, takes them in, and in an instant swallows them."

In all this there is nothing beyond what arises from the desire of the animals to drive away a savage foe, against which they have an instinctive hatred, from the precincts of their nests, and in their eagerness and anxiety often advance so close as to bring themselves within the reptile's power. In other instances they are startled by the dreaded snake's sudden appearance, and become bewildered or paralyzed with terror. Fig. 2306 shows a small species of Opossum suddenly surprised by the unexpected appearance of a Rattlesnake.

After all it is very doubtful whether living birds are the common prey of the rattlesnake. Some experiments by Mr. Pence on a rattlesnake, and also on a black snake (not venomous), seem to prove this. A living bird (an oriole) was introduced into the cage of the rattlesnake, and remained there for two days without betraying the least fear, or experiencing the slightest molestation from the reptile, which, however, devoured a dead bird, while the oriole hopped about untouched. A cardinal grosbeak was then introduced, and this, so far from avoiding the snake, pecked at ease about the cage, picked up the seeds, and even hopped on the snake's back, but retreated on hearing the sound of the rattle. Frogs, both living and dead, were presented, but it would not touch them. The black snake, on the contrary, instantly seized them. At last a common rat was put into the rattlesnake's cage. Scarcely was it fairly in when the reptile appeared animated; the rat fled in alarm to the opposite side of the cage, to escape the snake, which now gave chace, following the rat very deliberately; strenuous were the efforts of the terrified victim to avoid its pursuer, but in vain; the snake, seizing a favourable moment, struck its prey and then remained motionless; the rat ran about for a little time as if bewildered, and at the end of a minute became swollen and died in convulsions; it was then swallowed.

We may now turn our attention to the venomous snakes, in which there are maxillary teeth behind the poison-fangs.

2307.—The Banded Bungarus

(*Bungarus fasciatus*). In the genus Bungarus of Daudin (Pseudoboa, Oppel.), the head is short, covered with large plates, and not remarkable for any great breadth or swelling of the occiput, as in most venomous snakes; the scales down the ridge of the back, as in dipsas, are larger than the lateral scales; the subcaudal plates are simple; there is no dilatable hood as in the allied genus Hamadryas.

The snakes of the present group are natives of India, where they are called rock serpents, according to Cuvier, who also informs us that the name which the banded species bears in Bengal is Bungarum-Pamma, whence the barbarous term Bungarus, used by Daudin, and now generally adopted.

The banded bungarus is a formidable reptile attaining to the length of eight feet. The specimens we have examined (preserved in spirit) were of a yellowish white, with annular bands of black. There are several other species, as B. cœruleus, B. lividus, &c.

Family HYDRIDÆ (MARINE SNAKES).

These singular animals are truly aquatic in their habits, and by the compression of their form, and especially of their tail, admirably adapted for swimming, by means of a series of eel-like movements. Indeed, excepting that they are destitute of fins, and are covered with scales, they closely resemble eels in their general appearance.

We have yet to learn many points respecting these snakes, which are all confined to the warmer latitudes, and are often seen collected in shoals in the Indian seas, giving chace to fishes and other prey. Occasionally they are carried out by storms to extratropical latitudes, and drifted upon distant coasts, an instance of which occurred on the shores of New Zealand, as we have previously mentioned (Proceeds. Zool. Soc. 1838, p. 4).

It would seem that these snakes only occasionally visit the land, if indeed they ever leave the water; indeed we are not aware that any have ever been caught on shore; and they can only live for a short period out of salt water. Russell, in his beautiful work on Indian serpents, states, that "It is remarked by the Rev. M. John that he never found a land, a river, or a tank snake with a flat tail; such as are sometimes found in rivers have been brought in by the tide, and can only live a short while out of salt water. He further remarks it is difficult to procure sea-snakes, for though often caught in nets they are held in such dread by the fishermen, that hardly any inducement can procure them." Though possessing maxillary teeth, these serpents are highly venomous; nevertheless many naturalists have asserted the contrary, and even, in some parts, the natives of India have the same erroneous idea, so that the assertion of the Rev. M. John that they are dreaded by the fishermen must be taken with some limitation. The following extract from the Proceeds. Zool. Soc. 1838, p. 80, may not prove uninteresting. It is the summary of a paper on Marine Serpents by Dr. Cantor:—"This communication embodies the results of Dr. Cantor's observations upon the habits and general conformation of the Marine Ophidians, a group of Vertebrata to which but little attention has hitherto been given, from the circumstance of the danger attending their examination in the living state, and also from their geographical distribution being entirely confined to the tropical seas. The author being stationed, in the East India Company's service, on the Delta of the Ganges, had, during a considerable period, most favourable opportunities for studying these serpents, many of which were captured in the nets employed for fishing. His observations are principally directed to the anatomical characters which distinguish the marine from the terrestrial serpents, and to the modifications of structure by which the former are adapted to the element in which they exist. With respect to their physiology, the principal point of interest he establishes is, the circumstance of all the species, without exception, being highly venomous, a fact which has been denied by Schlegel, who states that the marine snakes are harmless; and the same erroneous idea is very current with the natives. Dr. Cantor in proof of the contrary refers to the recent death of an officer in Her Majesty's service, within an hour or two after the bite of a serpent which had been caught at sea, and also to numerous experiments of his own, in which fowls, fish, and other animals invariably died within a few minutes after the bite had been inflicted. Numerous sketches were exhibited to the meeting in illustration of Dr. Cantor's observations."

Though marine snakes are not found naturally inhabiting rivers or lakes, yet they abound in salt-water creeks and ditches. The species are very numerous, about fifty species being known, of which most are in the magnificent collection of the British Museum. We have already alluded to the occurrence of these animals around the shores of the Samoa or Navigators Islands, where they are eaten, and not at Tahiti, as stated by Cuvier, for they are there unknown.

Mr. Gray (Proceeds. Zool. Soc. 1837, p. 135) observes that "The family of Hydridæ (as far as known up to that date) consists of twenty-three genera, and forty-eight species, of which twenty are found in the Indian Ocean, and sixteen in the salt-water ditches of India and the neighbouring islands, and six are found in similar situations in tropical America."

2308.—The Bicoloured Sea-Snake

(*Pelamys bicolor*). Hydrus bicolor, Schn.; Anguis platurus, Linn.

In this genus the head is covered with large plates, and the occiput has a swollen appearance by reason of the development of the pedicles of the lower jaw, which is very dilatable; the scales of the body are small, equal, and disposed like the pieces forming a pavement of hexagons. The colouring is black above, yellow below. It is probably this species which Mr. Williams observed at Savaii, Upolu, &c.; the snakes cast on New Zealand were the same: the tail is shaped very like that of an eel.

2309.—The Banded Sea-Snake

(*Chersydrus fasciatus*). Oular limpé of the Javanese; Acrochordus fasciatus, Shaw.

The peculiar scaling of the head and body is exhibited with the pictorial specimen, from which it will be seen that the scales down the ridge of the back are hexagonal and larger than the small lateral scales.

Cuvier says that this species inhabits the bottom of the rivers in Java, and is very venomous. We should rather suspect he meant the saline creeks and ditches of that island, for, as already observed, none of these serpents inhabit fresh water. It is alternately annulated with black and white.]

The peculiar forms of the Hydridæ may be contrasted with those of the terrestrial snakes, of which we give a few additional examples.—Fig. 2310, a group, representing several of the most remarkable, is depicted. The boa, the cobra, the rattlesnake, the viper, and cerastes are conspicuous.

Fig. 2311 is a spirited representation of the attack upon a sleeping lascar by a monstrous python, noticed in our account of that reptile; the fatal conclusion was prevented by the opportune return of the party, who destroyed the snake, which was found to exceed sixty-two feet in length. The narrative was first published in the 'Oriental Annual,' and the engraving is copied from a painting by Mr. W. Daniell, now in the possession of the Baron de Noual de la Loyrié.

Fig. 2312 represents a group of snakes coiled together, aroused from their state of hybernation.

Fig. 2313 is a second pictorial specimen of Herpeton tentaculatus.

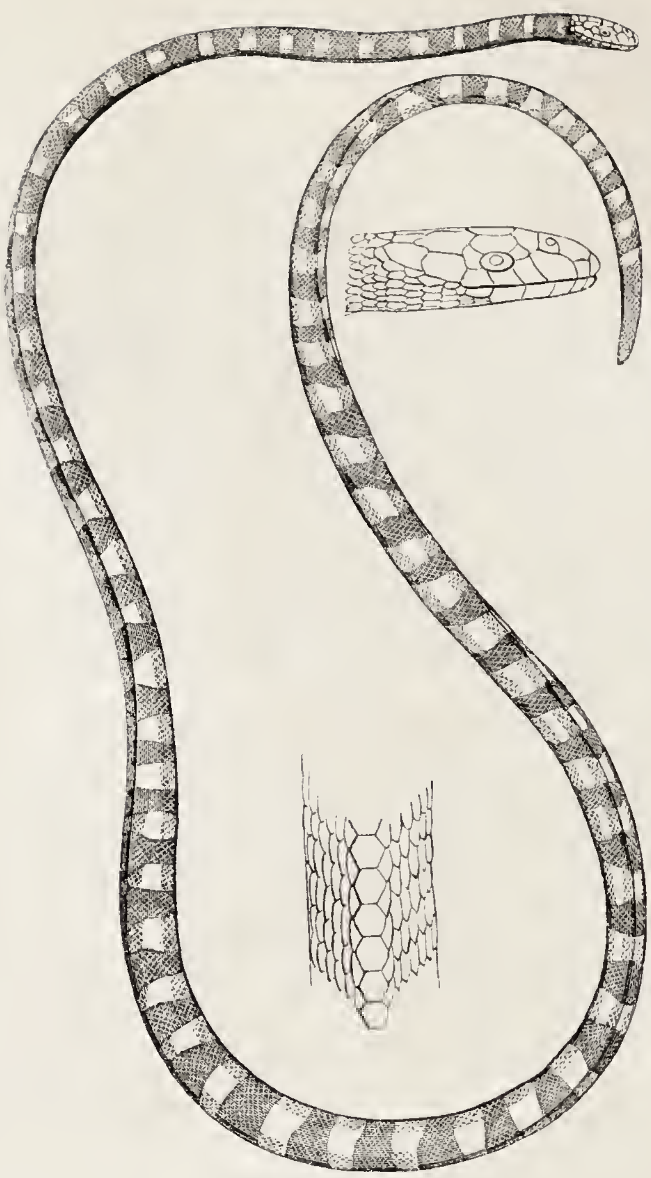
ORDER AMPHIBIA.

Taken in its strict sense the term amphibia (Ἀμφίβιος, utrimque vitam habens, having a double life) is applicable only to such animals as have the power of living indifferently both in the water, respiring by means of gills, and on the land, breathing by means of lungs, lungs and gills (or branchiæ) being at the same time possessed. Certain genera in the present order are, indeed, thus organized, as Proteus, Siren, Menobranchus, &c. By an extension of the term, however, it includes those reptiles also beginning life as aquatic beings with branchiæ, which are afterwards lost, true lungs becoming developed, with an according change in routine of the circulation; such for example are the frogs, newts, &c.

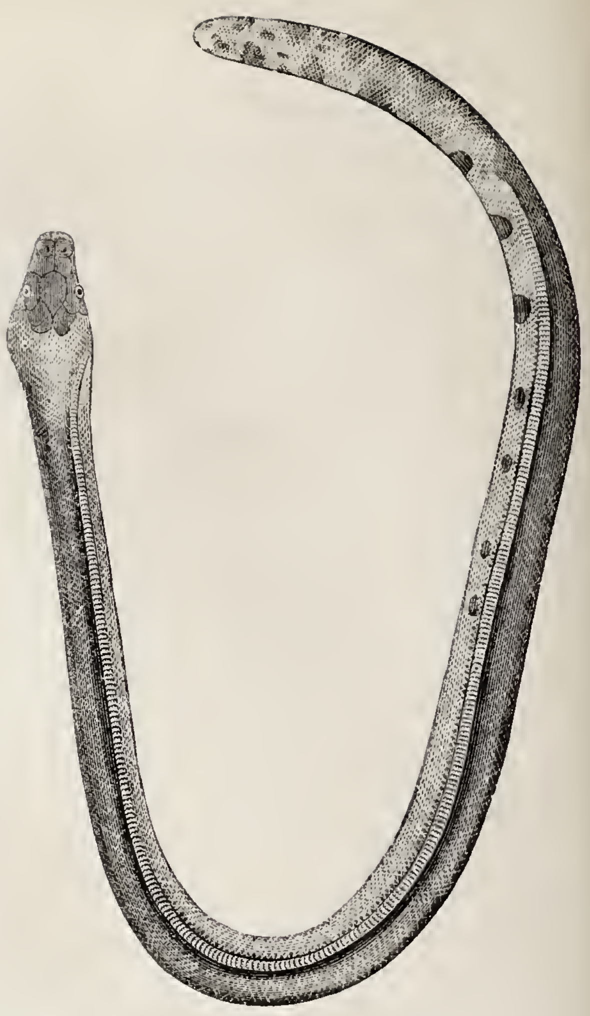
Many naturalists of great eminence, and among them Mr. Bell (see 'British Reptiles'), consider the amphibia as constituting a distinct class; nevertheless we are inclined, with MM. Duméril and Bibron, to regard them as forming only an order or great section of the class Reptilia, and we agree with a talented writer in the Penny Cyclopædia, who expresses himself in the following words:—"We confess that, after some consideration and examination, we do not think that the organic differences between the true reptiles and the amphibia, as they are termed, are sufficient to warrant a separation into two distinct classes. The amphibia may be considered as a division or subclass, but it is too much in our opinion to say that a Salamander (Salamandra) and a Sand-lizard (Lacerta agilis) belong to different classes."

With respect to the general characteristics of the amphibia, it may be stated that the ventricle of the heart is single, and that the skin is naked, being defended neither by plates nor scales; it is usually

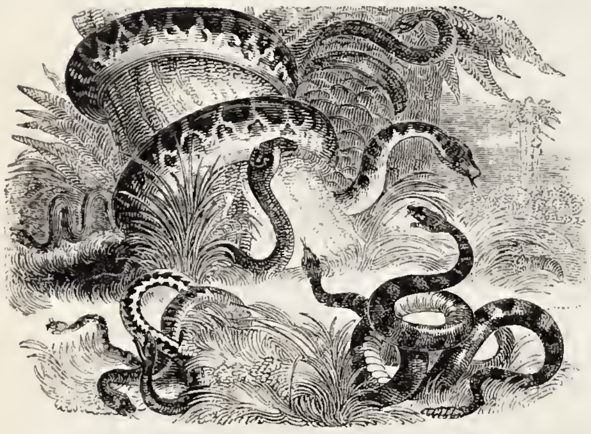
2307.—Banded Bungarus.



2309.—Banded Sea-Snake.



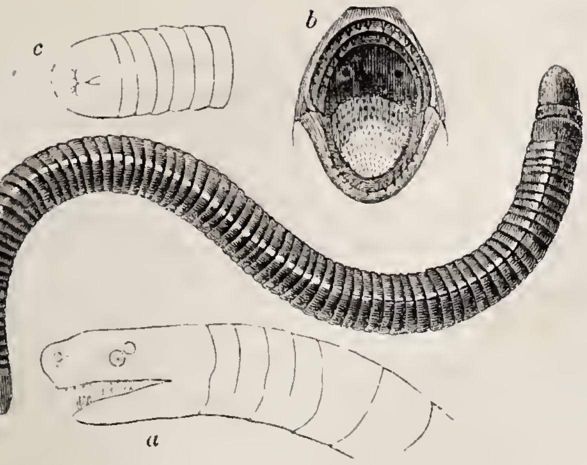
2308.—Bicoloured Sea-Snake.



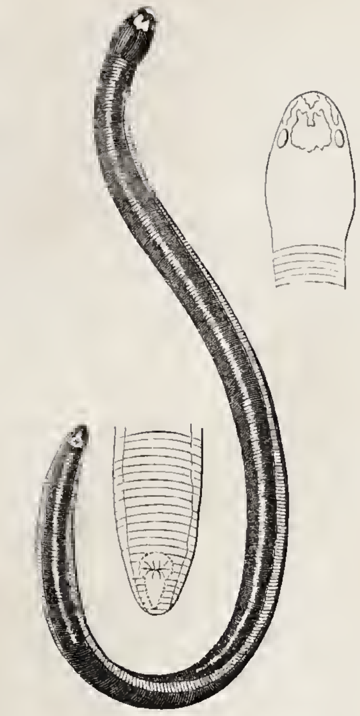
2310.—Group of Terrestrial Snakes.

2312.—Snakes aroused from hybernation.

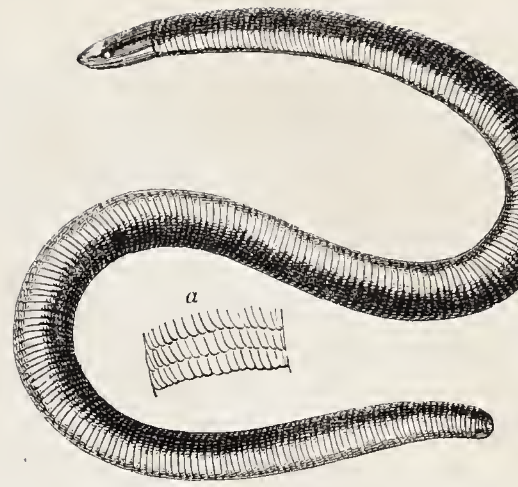
2311.—Boa attacking a sleeping Lascar.



2316.—Ringed Cæcilia.



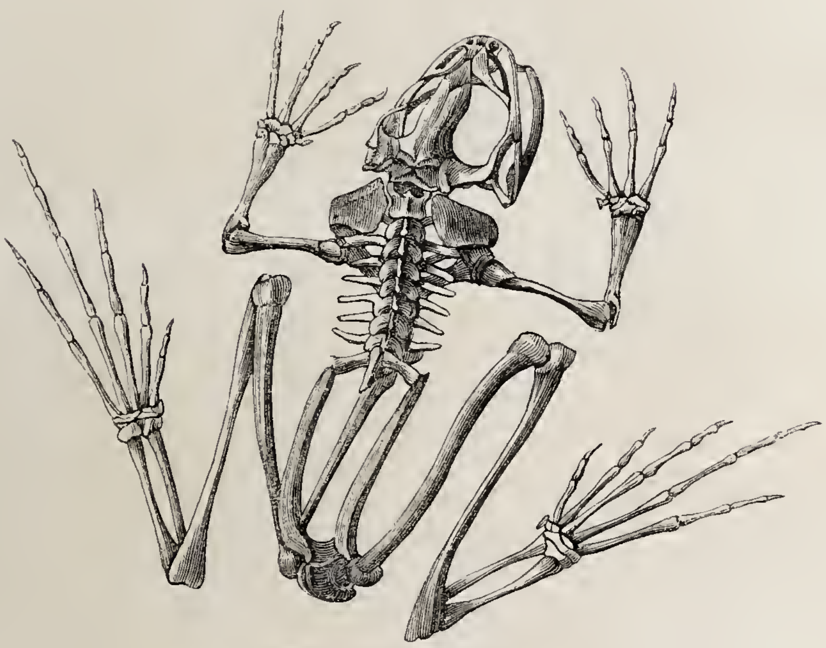
2317.—Two-banded Cæcilia.



2318.—Two-banded Cæcilia.

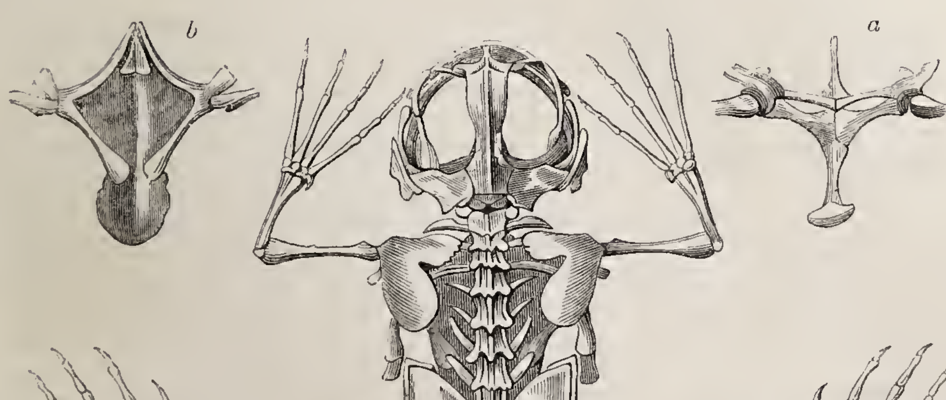
2315.—Head of Wormlike Cæcilia.

2314.—Skull of Cæcilia.



2319.—Skeleton of Common Frog.

2321.—Water-Frog.



2320.—Skeleton of Cape Dactylæthra.

2313.—Herpeton tentaculatus.

moist, or clammy, and pours out a fluid secretion. As in snakes and lizards, the cuticle is frequently shed and renewed. The form is variable; sometimes the limbs are wanting: the skull is united to the vertebral column by two condyles, or articulating processes, instead of by a single process, as in snakes and lizards. When the fore-limbs are present there is (more or less developed) a sternal or breast bone; the ribs are either rudimentary or wanting. The toes are unfurnished with claws, but sometimes protected by little horny sheaths.

We cannot here overlook the curious fact, that in some, as the frog, the humid and delicate skin co-operates with the lungs, affording an extensive surface for the aeration of the blood in the minute capillary vessels. This cutaneous respiration can only take place, as various experiments tend to prove, while the skin is bedewed with moisture; hence the abundant secretion of fluid for the purpose of preserving its necessary degree of humidity; for, as we have often observed, in hot weather, even when the frog has no access to water, its skin is still wet; and, as was first ascertained by Townson, a peculiar sac, erroneously regarded as the bladder, serves as a reservoir of pure fluid for the supply of the system with the moisture necessary to the continuance of the vital operations.*

We have said the amphibia commence existence as aquatic beings, furnished with fringe-like tufts, gills, or branchiæ, for the respiration of water, and that in some these branchiæ remain, even when the lungs are developed; but that in most they become obliterated, upon the development of those organs. Hence are the amphibia resolvable into two primary sections, namely, Caducibranchiate amphibia (caducus, perishable), and Perennibranchiate amphibia (Perennis, persistent).

Caducibranchiate amphibia.

Family CÆCILIADÆ.

The Cæciliadæ are regarded by Cuvier as constituting one of the families of the serpents, "Les serpents nus;" he observes however that many naturalists place them with the amphibia, "though we are ignorant whether or not they undergo any metamorphosis."

According to Müller, however, gill orifices have been detected in a very young specimen of Cæcilia in the Museum of Leyden, within which were black coloured gills or fringes apparently fixed to gill arches; the openings communicated freely with the cavity of the mouth. This would appear to determine the question and justify the naturalists who have assigned these reptiles to the present situation.

Of an elongated and snake-like form, the examples of this family have the skin naked, smooth, and viscous, and marked with a series of annular depressions more or less distinct. In the substance of this smooth skin, thin scale-like laminæ of minute size are found to be imbedded, in regular transverse rows. The eyes are very small, and sometimes either wanting or buried beneath the skin. The vertebræ resemble in their form and mode of union those of fishes. The head is depressed, the tongue thick, rounded, and velvety, and usually presents two eminences corresponding to the posterior nostrils. The lower jaw is not articulated to the skull by means of movable pedicles as in the snakes, and the tympanic bones are impacted with the other cranial bones. There are palatal as well as maxillary teeth; they are strong, recurved, and simple. There are, besides the true nostrils, two little pits or depressions, one on each side, beneath the former, and generally termed false nostrils. There is no sternum, and the ribs are too short to encircle the body. Fig. 2314 exhibits the Skull of Cæcilia in two views.

The tail is extremely short and blunt, or even wanting.

These singular reptiles are respectively natives of the warmer parts of America, of India and the Islands, and of Africa. MM. Duméril and Bibron enumerate eight species, assigned to four genera.

According to M. Laprieur, the Cæciliadæ are ovo-viviparous, producing six or seven young at a birth: their habits, however, are little understood. They bury themselves in the humid earth and mud of marshy places, piercing their way like worms, often to the depth of several feet. On the surface of the ground they creep slowly along, and when in the water swim like the eel, waving the tail and hinder part of the body from right to left. Cuvier states that vegetable matters, mud, and sand, have been found in the stomach of specimens examined.

2315.—The Worm-like Cæcilia

(*Cæcilia lumbricoides*). Head of; *a*, seen in profile; *b*, with the mouth open, showing the tongue, with its two eminences; the internal orifices of the nostrils, and the teeth. In this species no eyes are to be perceived through the smooth skin that covers the head; the fosset beneath each nostril is very distinct.

The general form is long and slender, the length being about two feet, and the circumference of the body not more than that of a common goose quill. There are no rings or annular depressions, excepting at the hinder part of the body, where they appear varying in number from twelve to fifteen. The tongue adheres by its edges completely to the lower jaw, so that it is not free or capable of protrusion. The general colour is brownish or olive. The species is a native of Surinam.

2316.—The Ringed Cæcilia

(*Siphonops annulatus*). Cæcilia annulata, auct.

In this genus the body is cylindrical, the head blunt, the teeth strong, the tongue large, and adhering on all sides, with the surface marked with vermiculiform furrows. The eyes appear distinct through the skin, and a little below and before each, is placed a fosset or false nostril.

The ringed Cæcilia is an inhabitant of Brazil, Cayenne, and Surinam, and is remarkable for the distinctness of the annulations of the body generally. MM. Duméril and Bibron state that in no specimen have they been able to discover scales in the substance of the skin, probably from their extreme minuteness and the difficulty of detaching them from the close coriaceous tissue.

Referring to Fig. 2316—*a* represents the Head and Neck as seen in profile; *b*, the open mouth, showing the tongue, teeth, and internal orifices of the nostrils; *c*, the terminal extremity of the body.

2317, 2318.—The Two-banded Cæcilia

(*Rhinatrema bivittatum*). Cæcilia bivittata, auct.

In the genus Rhinatrema the head is depressed and elongated, the muzzle obtuse, the tongue velvety. The eyes are distinct through the skin. No fossets either under the eyes or nostrils.

In the two-banded Cæcilia, the rings are very numerous round the body from the head to its termination, amounting to three hundred and forty. These rings or folds may be easily raised up, so as to expose a great number of circular transparent scales relieved by projecting lines, and forming a sort of net. Referring to Fig. 2317, the head and under surface of the terminal extremity of the body are exhibited with the species: and at Fig. 2318, *a* is a representation of the scales. This species is believed to inhabit Cayenne. The general colour is black, with a yellow stripe along each side.

Family RANIDÆ (FROGS, &c.).

The Anoura, or Anura, of some naturalists.

The Ranidæ, when in their adult or perfect condition, are all destitute of a tail; hence the terms anoura, or anurous batrachians, by which they have been denominated. In these animals the form of the body is broad and short; the limbs are four, of which the hinder are mostly far longer and more muscular than the anterior. The head is flat and broad, the gape wide; the cerebral cavity small, and yet the brain scarcely fills it.

Fig. 2319 represents the Skeleton of the Common Frog; and Fig. 2320 that of the Cape Dactylæthra, one of the Pipas or tongueless Batrachians.

In the frog, the vertebræ are only ten in number, in the pipa eight; both are destitute of ribs: the pelvic portion is greatly elongated. The sternum is highly developed, and a large portion of it is often cartilaginous; it receives the two clavicles, and the coracoid bones, which support the scapulæ.

At Fig. 2320, *a* represents the sternum of the common frog; *b*, that of the Dactylæthra. In the latter there is a single free caudal bone, but which has nothing of the vertebral form.

In the true frogs (Phanéroglosses raniformes of Duméril) there are small teeth in the upper jaw, and in most there are even palatal teeth, or rather pointed processes forming a part of the bones to which they are attached, as in the cases of certain fishes. In the toads, however, the jaws are destitute of teeth.

The food of these reptiles consists of insects, slugs, &c., in the capture of which the tongue performs a leading part. This organ, which is soft and fleshy, and lubricated with a glutinous saliva, does not rest upon anything analogous to the os hyoides; but is fixed to the inner part of the front of the lower jaw, so that when in repose its base is anterior, and it lies back, its apex pointing towards the gullet, just the reverse of the ordinary position.

When the animal darts it forth at the prey, it becomes considerably elongated, and turns on the pivot of its anterior fixture, being reversed in such a manner that the surface which was undermost when the tongue was lying in a state of repose in the mouth, is now the uppermost, the original position being regained, when it turns on its pivot back again into the mouth. The rapidity with which the frog or toad launches this organ at insects or slugs is extraordinary, insomuch that the eye can scarcely follow the movement; never is the aim missed; the prey touched by the tongue adheres firmly, the viscid saliva being very tenacious, and is instantaneously carried to the back of the mouth, and swallowed.

We have often presented slugs on bits of straw or stick to toads, and watched with surprise the sudden disappearance of the prey, which seemed to vanish from the stick as if by magic.

It would appear that the senses of taste and smell are not very acute in these animals; their sight, however, is quick and accurate; there are lachrymal glands, and the tunica conjunctiva is pierced so as to permit the tears to run into the cavity of the mouth.

With respect to the organs of hearing there is considerable difference among these reptiles. In the true frogs and the tree-frogs, the large tympanic membrane is very distinct, just behind the eye, and indicated by the delicacy of its structure compared with the other integuments of the head. In the toads it is not apparent; and in the pipas it is protected by a sort of valve, as in the crocodile, in order that it may not be injured by the pressure of the water when the animals resort to great depths. A wide passage (the Eustachian tube) communicates from the internal auditory cavity with the back of the mouth (fauces), so that the tympanum is subjected to an equal pressure under every atmospheric change. It is indeed to be observed, "that the extent and freedom of the Eustachian passage are in relation to the size and exposed condition of the tympanic membrane, and perhaps also to its form, which is convex externally, and, therefore, the more liable to be affected by undue pressure from without, being only supported behind at a small part of its superficies." (Professor Owen.)

The voice of the frogs generally consists, as is well known, of a deep guttural croak; though some at least are capable of uttering a shrill cry of terror or distress. This croaking is produced by the air being driven from the glottis into the puffed-out cavity of the mouth, or into certain guttural sacculi, which in the males of many species, and particularly of the tree-frogs, are very large. This noise they can produce under the water as well as on the land:

> "Quamvis sint sub aquâ, sub aquâ maledicere tentant;
> Vox quoque jam rauca est, inflataque colla tumescunt."
> Ovid. Met. libr. vi. fab. 6.

M. Duméril says "la plupart (des batraciens) coassent, mais ce coassement est très-différent dans les diverses espèces des grenouilles; les unes beuglent, aboient, grognent, ou ricannent; d'autres sifflent, piaulent, ou pipent. Certains crapauds produisent les sons flûtés de divers instrumens à vent."

The locomotion of these reptiles on land consists of walking, running, and leaping, with different degrees of rapidity and address. Most are admirable swimmers, propelling themselves through the water by vigorous strokes of the hind limb aided by their large webbed feet. The muscles of the thigh and leg in the frog offer a great similarity to the arrangement of the same parts in the human subject. All hybernate. The frog seeks the mud at the bottom of marshes, lakes, and ponds, congregating in multitudes, which huddle together, forming a compacted mass; the toad chooses some hole in the ground, under stones, or the roots of a tree, and there passes the months of winter. It is time, however, that we notice our pictorial specimens.

2321, 2322.—The Water-Frog

(*Rana Halecina*, Kalm). Rana palustris, Guér.; Rana pipiens, Schreb; Shad-frog, Bartram.

This species in North America represents the green or esculent frog of the European continent, which it closely resembles in habits and colouring. In the male water-frog, however, there are no fissures at the angles of the mouth, as in the European species, for admitting the external protrusion of the vocal sacculi; and the head is of a more pointed form. The orifice by which the air penetrates into the vocal sacs, is situated on each side immediately under the Eustachian tube leading to the internal ear. This species is extremely active, and when pursued will take leaps clearing eight or ten feet at a spring. It frequents the borders of ponds and lakes. The general colour is brown, olive, olive grey, olive brown, or bright yellowish green; the back is ornamented with black rounded spots, bordered with yellow; there is always one over each orbit, and sometimes on the forehead; a black streak runs from the eye to the tip of the muzzle: another forked at its posterior extremity runs above the tympanum, and a third is seated on the forepart of the shoulder; the jaws are marbled with black and white, and a whitish yellow or bronzed stripe runs along each side of the head, and also along each side of the back, where the cutaneous glands are apparent. The hind-limbs are marked with large

* The skin not only exhales but absorbs water; according to Townson, the frog often absorbs a weight of water equal to that of its own body in a very short time, and only by the skin of the abdominal surface. It is easy to see how the moist earth will afford this essential of existence, so that the exhalation and absorption may balance each other.

spots of black edged with whitish. The voice of this frog is a chirping or piping note, not unlike that of a bird.

2323.—The Bull-Frog

(*Rana mugiens*). This species, which is common in North America, attains to a very large size, measuring upwards of six or seven inches in the length of the head and body. It is essentially aquatic in its habits, seldom wandering far from the water, to which it immediately resorts for safety; and at the bottom of which it makes a hole or fissure, its habitual hiding place. It is said to live in pairs. It is extremely voracious, preying upon fishes, freshwater mollusks, various reptiles, and even snakes; young water-fowl also fall a prey to its rapacity, and broods of young ducks often entirely disappear, to the surprise of their owner, who little suspects the real depredator. The power of this frog is very great, and it has been known to clear without apparent effort a barrier of three feet in elevation. During the spring and summer, its loud croak may be heard resounding amidst the swamps, or the lakes, even to a very great distance. Audubon says "it is particularly fond of such small pure streams of water as are thickly shaded by overhanging bushes; it sits for hours during the middle of the day basking in the sun, near the margin of the water, to which it betakes itself by a great leap, on the least appearance of danger, diving at once to the bottom, or swimming to the opposite side. In the southern states it is heard at all seasons, but principally during the spring and summer months." He adds that the hind-legs are white, tender, and excellent eating. Some specimens weigh as much as half a pound. In the West Indies and South America an allied species of huge size, also called bull-frog, and by the French Crapaud (Rana ocellata, Linn.), is reared for the use of the table. It is the R. gigas and R. pachypus of Spix; Cystignathus ocellatus, Wagler.

2324.—The Painted Frog

(*Discoglossus pictus*). The genus Discoglossus has the tongue rounded, entire, and free at its posterior edge. There is a row of palatal teeth; the tympanum is concealed under the skin; there are a few folds or glandular eminences about the sides of the neck and shoulders. The toes are completely free; five in number, of which one is a mere tubercle; the webs of the hind-toes are short; the males are destitute of vocal sacs.

The painted frog is one of the few species found in Africa; it exists in Egypt, and along the Mediterranean shores; and occurs also in Greece, Sicily, and Sardinia. It frequents rivers, streams, and lakes, and both freshwater and saline morasses, like the green or esculent frog, in company with which M. Bibron says that he has often seen it in Sicily. It lives on insects, spiders, and both terrestrial and aquatic mollusks. It is said to abound in the Nile; we may, however, observe, that the green frog of continental Europe also exists in Egypt and Algeria, as well as throughout the greater part of Asia to Japan.

The painted frog is subject to considerable variation of colouring; it is generally marbled above with grey or brown, on an olive or yellowish green ground, with a white line down the middle of the back, and sometimes also along each side.

2325.—Boie's Ceratophris

(*Ceratophris Boiei*, Wied.). Ceratophris granosa, Cuv.

The singular frogs of this genus, all American, have a large head and a granular or tuberculous skin; the tongue is heart-shaped; the edge of the upper eyelid is prolonged into a point, giving a horned appearance to the top of the head, which is covered with ridges and asperities more or less decided. The mouth is very wide; the limbs rather short; the toes four; the webs very little developed. The surface of the body is covered with tubercles, and one species (C. dorsata) is defended by a sort of dorsal buckler formed by the union of numerous osseous laminæ in the substance of the skin.

It would seem that the males have the vocal pouch, at least such has been detected in the C. Boiei. In this species the palpebral prolongations are very remarkable, and pointed, and the whole of the surface of the body is covered with granular tubercles. Two ridges run down the back from the palpebral horns, festooned on each side by brown, the general ground-colour being yellowish. There is a triangular mark of black on the top of the head. Under parts yellowish spotted with black. It is a native of Cayenne.

We may now pass to the tree frogs, (Les Phanéroglosses Hylæformes of M. Duméril). These active little creatures are essentially arboreal in their habits; bird-like they pass their time amidst the foliage of the trees, perching upon the leaves and twigs, and spring from one to another with wonderful quickness and celerity. There they pursue their insect prey, or lurk for it, and seize it as it passes. If we look at the toes, we find them each provided with large expanded suckers or discs, by means of which they adhere even to the smoothest leaf, or lurk with the back downwards on its under surface, as the Geckos, and so proceed from one to another with singular address.

Exposed to numerous enemies, they are capable of assuming different tints, by way of masking their presence, with almost instantaneous celerity; or of adapting them so as to blend with surrounding objects. They have also another singularity; the skin of the under-surface, instead of being smooth, is covered with granular glands, pierced by a multitude of pores, by means of which the dew or rain spread on the surface of the leaves is rapidly absorbed for the supply of the system. This group is divided into several genera. By far the greater number of species are American. One only is found in Europe and Africa.

2326.—The Green Tree-Frog

(*Hyla viridis*). Rana arborea, Linn.

This beautiful little creature is found over the whole of middle and Southern Europe and Northern Africa; it occurs also in Japan. It has never been observed in our island, though it is not uncommon in France.

It is amidst the foliage of woods, that this species dwells during the months of summer, where it displays the habit of a cat, in watching for, and darting upon its prey: it lurks amongst the leaves, or under their canopy, and with open mouth launches itself upon the unwary insect, which it touches with its tongue and instantly swallows; some have compared its manners to those of a flycatcher, from its restless activity and unceasing repetition of short darts which it makes from leaf to leaf, as it watches the movements of the insects flitting about it. Towards the end of April the tree-frog quits its leafy abode for the water, in order to deposit its eggs, and it also hybernates like the common frog in the mud at the bottom of swamps and marshes. The young remain in their tadpole state for about two months, when their final change takes place, and they make their way to the adjacent thickets, where vast swarms are sometimes seen all in ceaseless motion, like flocks of minute birds. This species does not acquire its full size till the fourth year. The gular vocal sac of the male is capable of enormous distention; and the loud croak of numbers assembled together, uttering their voices in chorus, may be heard to a considerable distance.

The general colour of this frog is a fine green above, white beneath; a yellow stripe bordered with pale violet extends along the sides of the head and body, and down the hind-legs to the feet; and a similar stripe branches off and runs down the fore-limbs to the feet. After the spring the animal changes to brown, which soon gives place to grey, mottled with reddish, and this passes into blue; the green reappears with the return of spring.

2327.—The Bicoloured Tree-Frog

(*Phyllomedusa bicolor*). Rana bicolor, Gmel.

The most remarkable distinguishing character in this genus, is the opposability of the first finger of the fore-paws to the three others, and of the first two toes of the hind-paws to the three others; and by this arrangement, the hold, secured on leaves or twigs, is rendered extremely secure. The back part of the head is extremely broad, from the development of large parotid glands which begin behind each eye, and extend to the axilla, covering the scapulary region, and continued in a narrow line along each side.

The Bicoloured Tree-frog is a native of Cayenne and Brazil; its general colour above is a beautiful blue; the sides are marked with white spots, encircled by chestnut; a white line, bordered by brown, runs along the outer edge of the fore-arm and of the leg and foot. Under parts white, sometimes variegated with brown or chestnut.

The Toads next present themselves to our notice (les Phanéroglosses bufoniformes of M. Duméril). The toads in general have an inflated body, a warty or tubercular skin, and a tumour behind each eye, produced by a large parotid gland. The males have for the most part a gular vocal sac. In some genera, the toes are furnished with sucking-discs (viz. Dendrobates, and Hylædactylus), which resemble the true tree-frogs in their habits.

The upper jaw is altogether destitute of teeth. In the more typical forms the hind-limbs do not much exceed the fore-limbs in length, and their locomotion is a sort of crawl, or succession of shor thops.

Most are nocturnal in their habits, and come abroad with the dusk in quest of prey.

2328.—The Common Toad

(*Bufo vulgaris*). This species is too well known to need a detailed description. Though not very attractive in its appearance, the toad is far from meriting the opprobrium which has been lavished upon it. To the gardener it is a useful assistant, as it devours slugs, earwigs, caterpillars, and beetles. It has been celebrated for two things, namely, the brightness of its eyes, and its poison. Its eyes are certainly brilliant, and notwithstanding the poet's assertion, the only jewel it wears in its head. With regard to its being poisonous, we may observe that the glandular tubercles of its skin pour out an acrid secretion; and this is intended evidently as a defence, for we have often seen a dog seize one of these animals and instantly drop it, shaking his head in evident distress, while frothy saliva filled his mouth, and continued to flow for a considerable time. The parotid glands open externally by numerous pores, and give out a milky fetid humour. The common belief that the toad "spits venom" is absurd.

The toad is easily rendered familiar. Mr. Bell records a notice of one which would set on one of his hands, and eat from the other; and the story of Mr. Arscott's toad in Devonshire which lived for thirty-six years domesticated, and was killed by accident, has been often quoted from Pennant.

It is to Mr. Bell that we owe the first authentic account of the manner in which the toad disengages itself from its slough; the cuticle slits down the middle of the back and belly, thereby allowing the legs to be withdrawn in rotation; it is then rolled into a ball, pushed by the two paws into the mouth and swallowed at a single gulp.

Like the frog, the toad deposits its eggs in the water, but rather later in the spring. In August the tadpoles have completed their transformation, and creeping ashore disperse themselves over the land. Large troops of these young toads may often be met with.

Most persons have heard of the marvellous accounts of living toads found imbedded in the hearts of trees, or in solid blocks of stone; and it must be confessed, that many of the instances are supported by no mean authority; Smellie (in his 'Philosophy of Natural History'), Guettard (in 'Mémoire sur différentes parties des sciences et desarts' 1771 , Edwards, and Mr. Thomas (in 'Silliman's Journal') respectively notice examples of the occurrence in question. Be it however observed, that the stone or wood was never rigidly examined, nor is anything ever stated to disprove the possibility of a small aperture, communicating with the external surface, through which air, moisture, and insects may have entered; indeed, as Dr. Buckland says, "The attention of the discoverer is always directed more to the toad than to the minutiæ of the state of the cavity in which it was contained."

M. Herissant in 1777, Dr. Edwards in 1817, and Dr. Buckland in 1825-6, have proved by a series of experiments, that when deprived of air these animals speedily perish; but that they will survive for many months without food. Dr. Buckland's conclusions are that toads cannot live a year excluded totally from atmospheric air, and from experiments made by enclosing these animals in cells cut out in oolite, that they cannot in all probability survive two years entirely excluded from food. 'Zool. Journal,' vol. v.

It would seem then that accident must have introduced the toads in question into the prisons in which they have occasionally been found; that there they received food and air, and grew till too large to make their exit by the aperture which once admitted them; and which itself became much narrowed or partially blocked up; but still allowing sufficient air and moisture (most probably also minute insects) for the support of the system in a sort of torpid condition. Here then they would live till the blow of the hammer or axe set them at liberty, destroying at the same time all trace of the orifice or fissure which admitted them, and through which they received their scanty nutriment.

To suppose that toads imbedded in stone are thousands of years old, the living relics of a world gone by and coeval with the rock around them, is palpably absurd.

2329.—The Natter-jack

(*Bufo Calamita*). Bufo viridis, Laurenti; Bufo cruciatus, Schneid.; Bufo variabilis, Marr.

This species is spread through the greater part of Europe and Western Asia, as well as Northern Africa. In England it is tolerably common in certain localities; it has been found on Blackheath, Putney Common, in various parts of Lincolnshire, Cambridgeshire, and Norfolk. Mr. Bell quotes Sir W. Jardine's account of the occurrence of this reptile in a marsh on the coast of the Solway Frith, in brackish water, and within a hundred yards of spring-tide high water mark. They are, it is added, very abundant for six or seven miles along the coast. Dry spots, howeve, are its favourite haunts, excepting at the breeding season, when it visits the water. It is less crawling and slow in its movements than the common toad; and will even run with alertness for

2330.—Mitred Toad.

2327.—Bicoloured Tree-Frog.

2325.—Boie's Ceratophris.

2324.—Painted Frogs.

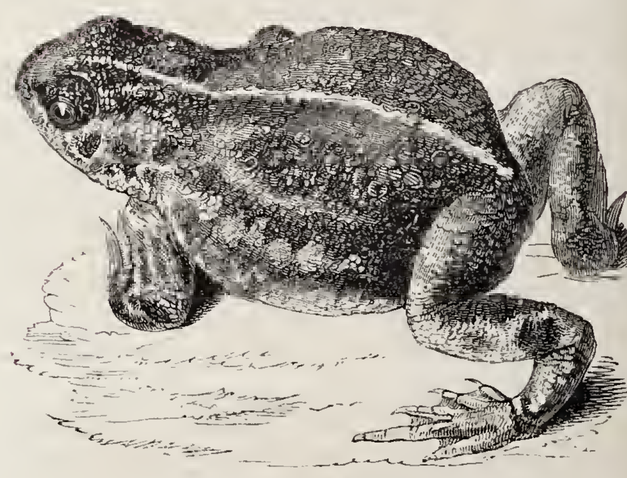
2331.—Bicoloured Toad.

2322.—Water-Frogs.

2328.—Common Toad.

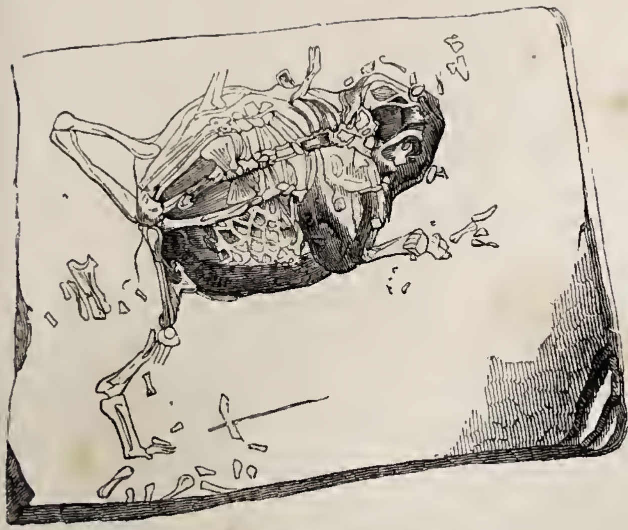
2323.—Bull-Frog.

2332.—Marbled Toad.

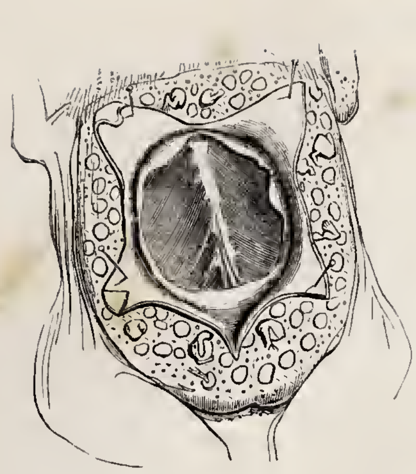


2329.—Natter-jack.

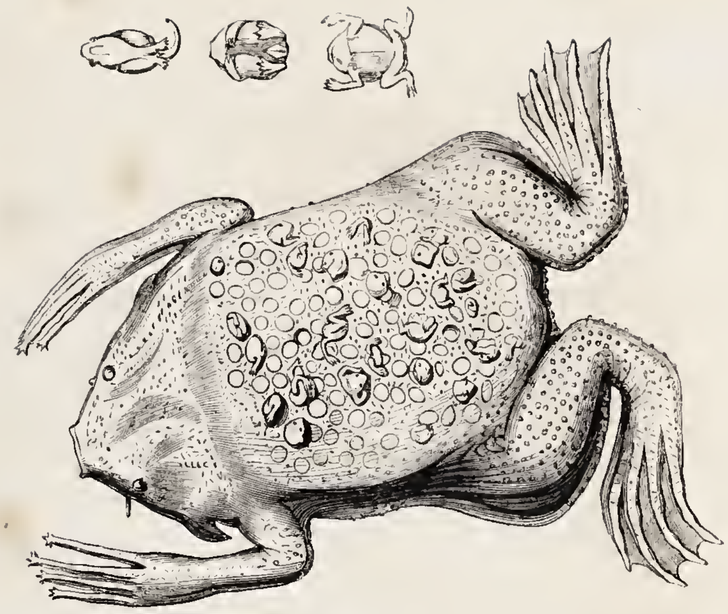
2326.—Green Tree-Frogs.



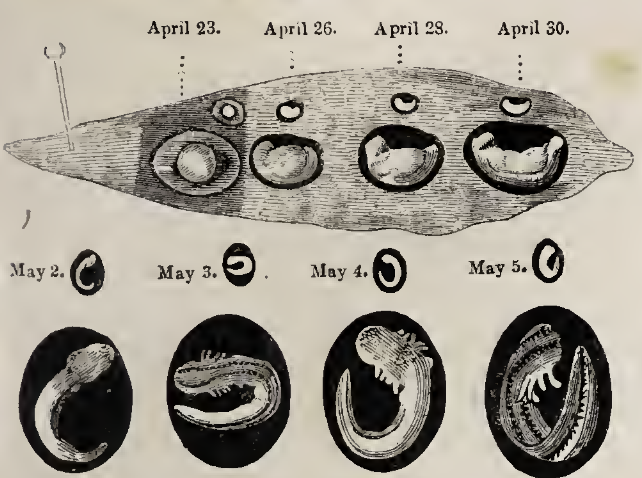
2333.—Gessner's Fossil Toad.



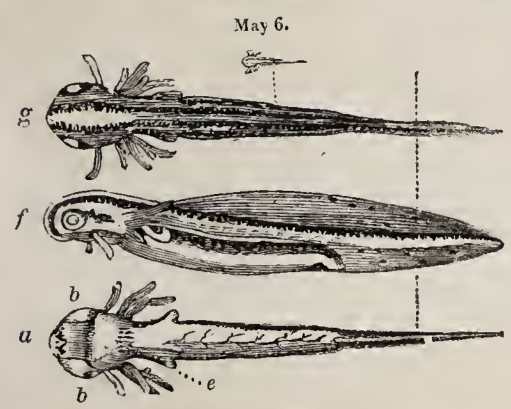
2335.



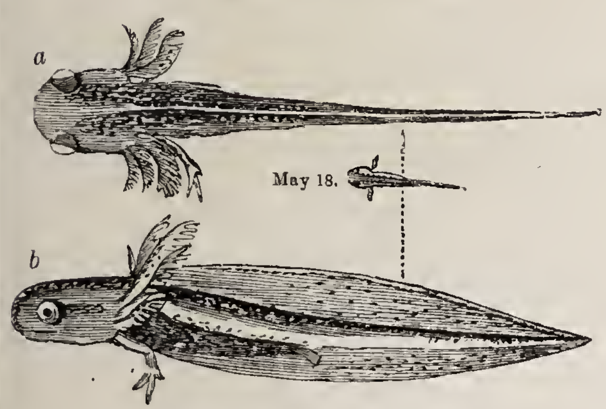
2334.—Surinam Toad.



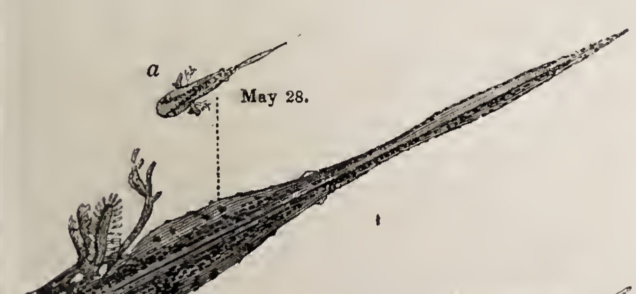
2340.—Eggs of Water-Newt.



2341.—Tadpole on leaving the Egg.



2342.—Tadpole at twelve days old.



2343.—Tadpole at 22 and 37 days.

2336.—British Water Newts.

2338.—Common Water-Newt. Female.

2337.—Common Water-Newt. Male.

a short distance. Its general colour varies, being grey, brown, yellow, or olive, with markings of a darker tint, mostly with a yellowish line down the middle of the back.

2330.—THE MITRED TOAD

(*Bufo margaritifer*, Daud.). Otilophis margaritifera, Cuv.; Rana margaritifera, Gmel.

This species, which is a native of Brazil and Guiana, is distinguished by a crest on each side of the head, extending from the anterior part of the orbit to the parotid gland, whence a fold of skin runs along each side of the body and down to the knee. The skin of the hinder quarters of the body and limbs is so loose and so little adherent to the muscles, that the thighs and adjacent parts appear as if enshrouded in a sac. The general colour is olive, yellow, or brown; often with marblings of a deeper tint. Under parts whitish, marbled with grey and brown. The muzzle is pointed, the head triangular.

2331.—THE BI-COLOURED TOAD

(*Engystoma ovale*, Fitzin.). Rana ovalis, Shaw; Oxyrhynchus bicolor, Valenc.. Guérin, and Cuvier; Stenocephalus microps, Tschudi.

This little reptile, remarkable for its small sharp-pointed head, is a native of South America.

In general the upper parts are chestnut, the under parts white; sometimes the upper parts are brown with a wash of slate blue; the under parts marbled or spotted with yellow and brownish red. Some have the throat black, and in all there is a whitish stripe along the back of the thighs.

2332.—THE MARBLED TOAD

(*Uperodon marmoratum*, Bibr.). Engystoma marmoratum, Cuvier.

Of this species little is known; it was discovered by Leschenault in the interior of India.

Its general colour is olive (green perhaps when alive) marbled with large markings of brown. Under parts white, excepting in the males, which have the throat black. In this species there are (as an exception to the rule) a few small teeth in the palate. The vocal sac of the male is capable of great extension.

2333.—GESSNER'S PALÆOPHRYNOS.

(*Palæophrynos Gessneri*, Tschudi). A fossil species of toad, the relics of which, with those of another species, Pelophilus Agassizii, are obtained from the Œningen beds. Fossil frogs have been found in the coal formation of the Rhine, together with the remains of certain fishes of the genus Leuciscus, viz. L. macrurus, and L. papyraceus.

We pass from the toads to the pipas, or Phrynaglosses pipæformes of Dumeril and Bibron, so called from the total absence of the tongue; in addition to this the internal auditory cavities communicate with the mouth only by means of a single minute opening in the middle of the posterior part of the palate. Two genera are known, each containing only one species, viz. Dactylethra, and Pipa.

2334.—THE SURINAM TOAD

(*Pipa Americana*, Laur.). Bufo dorsiger, Latr.

In this strange reptile, the head is large, flattened, and triangular, with the nostrils prolonged in the form of a little cutaneous tube; the eyes are very minute and vertical, the eyelids reduced to a simple rudiment, incapable of closing over the eyes. There are no teeth, either on the jaws or palate, nor are parotid glands apparent. The anterior paws have each four fingers, terminating in four star-like points; the hind limbs are short and thick, the feet large, and the toes, five in number, completely webbed. The body is broad and flat; a little barbule (barbillon) hangs on each side of the upper jaw, and an ear-like appendage on each angle of the mouth. The skin differs from that of all other Batracians, being covered with minute hard granules; amongst which are scattered small conical tubercles of a horny consistence. The male is distinguished by an enormous larynx formed like a triangular box of bone, within which are two movable pieces, the action of which influences the intonation of the voice.

The mode in which the eggs of this reptile are hatched, and the circumstances connected with the development of the young, are most extraordinary. It would appear that as fast as the female deposits her eggs, the male who attends her arranges them on her broad back, to the number of fifty or upwards. The contact of the skin with these eggs appears to produce a sort of inflammation; the skin of the back swells, and becomes covered with pits or cells, which enclose each a single egg, the surface of the back resembling the closed cells of a honeycomb. The female now betakes herself to the water, and in these cells the eggs are not only hatched, but the tadpoles undergo their metamorphosis, emerging in a perfect condition, though very small, after a lapse of eighty-two days from the time in which the eggs were placed in their respective pits. M. Bibron says, that the cells occupying the middle portion of the back are, according to his own observations, those which are the first cleared of the young, "because doubtless they are the first which are formed, or the first occupied."* These pits are only in the skin, and do not penetrate into the muscular tissue beneath, nor communicate with the interior of the body. Fig. 2335 shows the disposition of these cells and their situation on the skin, which is thrown back so as to expose the muscles below. The small separate figures are tadpoles in different stages of development.

The pipa, or Surinam toad, is of large size, or a brown or olive colour above, whitish below; it inhabits the marshes and swamps in the forests of Guiana, Brazil, and other parts of South America. According to Seba and Madame Merian, the negroes eat its flesh.

Before quitting the Ranidæ or anurous Batracians, we may allude to a belief of ancient date which yet prevails, that young frogs and toads are occasionally showered down with heavy rains, and that in great abundance, so as to cover considerable spaces of ground, where none had been previously observed; some have called in the aid of waterspouts, whirlwinds, and similar causes, to account for their elevation into the regions of air; and some have even thought they were formed in the clouds, whence they were precipitated. It has been generally in August, and often after a season of drought, that these hordes of frogs have made their appearance. Redi's explanation is doubtless the correct one: these toads and frogs, he says, "do not appear until it has rained for some time; but these animals had been hatched many days previously, or rather, had quitted the water in which they were developed as tadpoles, having undergone their complete transformation. These little frogs then lay concealed in the chinks of the earth, under stones and clods, where in consequence of their lying motionless, and often also on account of their dusky colour, they escaped the eye." With this account M. Dumeril agrees, observing that "the precise period of the year, the circumstance of rain always preceding the appearance of these young frogs and toads, which bear the signs of their recent transformation, and generally the total absence of any violent commotion of the wind, leave us in no doubt as to their origin. We have ourselves observed the phenomenon in question, once in Picardy, near Amiens, and once in the marshy meadows near Marbella in Spain; in the latter instance, it was a host of little frogs that made their appearance and covered our clothes, as M. Desgennettes, now present at the Scientific Meeting, may recollect." For further details we refer to the 'Erpétologie Générale,' vol. viii. p. 223.

We now pass to the Caudate Amphibia, les Urodèles of MM. Dumeril and Bibron.

Family SALAMANDRIDÆ (TRITONS AND NEWTS).

2336.—A GROUP OF BRITISH WATER-NEWTS:

a, the Common Water Newt (Triton Cristatus); *b*, the Common Smooth Newt (Lissotriton Punctatus); *c*, the Straight-lipped Water Newt (Triton Bibronii); *d*, the Palmated Water Newt (Lissotriton Palmipes).

2337.—THE COMMON WATER-NEWT

(*Triton Cristatus*), male.

2338.—THE COMMON WATER-NEWT

(*Triton Cristatus*), female.

2339.—THE COMMON SMOOTH NEWT

(*Lissotriton Punctatus*). *a*, Male, *b*, Female.

Of the Water Newts, four species inhabit the ponds, ditches, and clear sluggish or standing waters of our island. Lizard-like as these reptiles are in appearance, they must not be confounded with the lacertine group, with which Linnæus, overlooking their true characteristics, associated them under the common term of *Lacerta*. Like the frog, the newts begin their existence in a tadpole state, furnished with tufted gills or branchiæ for aquatic respiration, which become ultimately lost, and are replaced by true lungs adapted for a different medium. The process of this structural change, which is essentially the same as in the frog, we shall sketch as briefly as possible consistent with clearness.

On its first exclusion from the egg, the tadpole of the water newt exhibits on the sides of the neck the lobes of the branchiæ in a simple state, anterior to which are a pair of holders, by which the animal attaches itself to objects in the water. In about three weeks on the average, the anterior limbs have become developed, with terminal feet, fourtoed and distinct, the holders have disappeared, the branchial tufts have acquired a fringed character, and the eyes have assumed a definite outline; the little creature now moves about with considerable rapidity, propelling itself through the water by the undulatory movements of its laterally flattened tail. In a short time after this, the anterior limbs become more perfect, the hind limbs begin to sprout, and the branchial tufts, three on each side, are much enlarged and finely plumed. In a short time, the hind limbs, and feet with five toes, are completely formed, the body has attained its nearly perfect figure, and the branchiæ have assumed a deeper colour and firmer texture. The lungs are now rapidly developing, a change in the routine of the circulation is gradually taking place, and the branchiæ are becoming absorbed: towards the middle or close of autumn they disappear, and air instead of water becomes the medium of respiration. A similar transformation takes place in the tadpole of the frog, with this addition, that the hind limbs first appear, and the compressed tail becomes absorbed with the obliteration of the branchiæ. In the branchiæ of the tadpole of the newt and frog, when the limbs have made some progress, the circulation of the blood, when viewed through a good microscope, is calculated to excite the greatest admiration; their transparency is such as to permit the currents of globules rapidly coursing each other to be distinctly seen, as they ascend the arteries and return by the veins to the aorta. We may here state that in the tadpole condition of these animals, the circulation of the blood resembles that of fishes. The heart consists of one auricle and one ventricle; the auricle receives the blood of the general system, and immediately transmits it to the ventricle, which is muscular; from this ventricle it is propelled into an arterial bulb (bulbus arteriosus), and thence through a system of minute branchial arteries, and becomes subjected to the action of oxygen; from these arteries it merges into the branchial veins or returning vessels, which ultimately unite to form a systemic aorta, without the intervention of a second ventricle. As the branchiæ become obliterated, the pulmonary arteries develop, and the lungs begin to expand, till at last the branchiæ are lost, and the heart and circulation have assumed new characters. The heart now consists of two auricles and one ventricle; one auricle of small size receives the arterialized blood from the lungs; the other, which is capacious, the venous blood from the system, and both transmit their contents through valvular doors into the common chamber of the ventricle. The fluid thus mixed is sent through the bulbus arteriosus, and thence partly to the general system and partly through the pulmonary arteries, to undergo in the lungs the action of oxygen. The development of the tadpole of Triton cristatus, as observed by Rusconi, may be easily understood by reference to the following illustrations.

Fig. 2340 exhibits the evolution of the egg kept on the leaf, as deposited by the female. The stages are denoted by dates, from the beginning to the time in which the young animal is about to emerge. Each phase of the egg is shown of the natural size, accompanied by a magnified view of the same below. Fig. 2341 shows the tadpole on the day of its leaving the egg, May 6th; *a*, as magnified and seen from below; *b b*, are the two eminences formed by the globes of the eyes, and between them is a slight depression which afterwards becomes the mouth; *c*, is the holder of the right side; *d*, the gills of the same side; *e*, a rudiment of the fore limbs of the same side; *f*, the same animal in profile; *g*, the same seen from above.

Fig. 2342 shows the development on the 18th of May, twelve days after exclusion; *a* and *b* are magnified representations. The fore limbs are tolerably developed, and the branchiæ are becoming fringed. Fig. 2343 represents the same animal, as it appears on May 28th and June 12th; *a a*, natural size; *b*, magnified. In the latter, the branchiæ are beautifully fringed, and the hinder limbs are in process of development. Fig. 2344 shows the young newt in its last stage, July 18th, the branchiæ now beginning to shorten. This obliteration of the branchiæ goes on for five or six days more, when they become reduced to mere bud-like eminences; the branchial apertures have closed, the skeleton has become firmer, teeth have appeared, and by the 27th of July all traces of its former condition have entirely passed away; it has changed from the state of a fish to that of a reptile. It would appear that the changes described are retarded or accelerated according to the temperature. In our island the process is more protracted than in the warmer parts of the continent.

The great water newt (Triton cristatus) attains to the length of more than six inches, and is one of the most aquatic of its genus, residing almost constantly in the water; we have, however, captured it in meadows at the latter part of summer. Its bright orange-coloured abdomen, with distinct round spots of black, together with its size, prevent the possibi-

* It would seem that in females which have not as yet laid eggs, these pits are not to be seen; they begin to be developed when the eggs are first arranged on the back, the skin of which, after the young have quitted their tenements, appearing honeycombed all over. The cells afterwards become gradually obliterated.

lity of confounding it with any other species, except perhaps the Triton palmipes, of which the under surface is saffron yellow, or, as Latreille states, white without spots. The great water newt is active and voracious; it feeds during the spring and summer on the tadpole of the frog, and also upon the smaller species of newt, which it attacks and seizes with the utmost determination; it will also prey upon worms, insects, and mollusks, and may be taken by means of a hook baited with a small worm. It swims vigourously, lashing its compressed tail from side to side, its limbs being so disposed as to offer no resistance to the water; we have seen it crawl slowly at the bottom of clear ditches, as well as on the land, where, however, its movements are inert. It hybernates like the frog, generally in the mud at the bottom of ponds and ditches. Mr. Bell however states that he has found it hybernating under stones, and we ourselves on one occasion, early in the spring, saw several creeping out from under some large flags placed to support a bank; on taking up one by the tail, as we well remember, the tail, to our dismay, broke short off, and continued for some time to be rapidly agitated. On awaking from its lethargy in the spring, the male begins to assume a membranous dorsal and caudal crest, by which he is at once distinguished from the female. The dorsal crest has its edge indented, but that along the tail has the edge even; with the completion of the crest the colours become brighter and more decided, and the animal is more lively and vigorous. At the latter end of April and during the months of May and June, the female deposits her eggs, not as in the case of the frog, in multitudes all agglutinated together in a gelatinous medium, but one by one, each in a distinct spot from the other. Resting on the leaf of some aquatic plant, she folds it by means of her two hinder feet, and in the duplication of the leaf thus made, deposits a single egg, gluing at the same time the folded parts together, thus concealing and protecting the enclosed deposit. This process was first described by Rusconi, and has been minutely detailed by Mr. Bell from personal observation. The membranous dorsal crest of the male continues till autumn, when it is gradually absorbed; a trace, however, of the caudal crest still remains. In this species, the upper lip is slightly pendulous, the teeth are numerous and minute, a double longitudinal series occurring on the palate; the tongue is semi-globular, slightly free at the sides, and pointed behind; the head is flattened, the body cylindrical, corrugated, and covered with minute tubercles; there are two patches of simple pores on each side of the head, and a line of similar pores at distant intervals along each side of the body. The upper parts are dusky black or yellowish brown, with darker round spots; the under parts are orange red, with round spots of black; the sides are dotted with white, and the sides of the tail are to a greater or less extent of a silvery white.

The Common Smooth Newt (*Lissotriton punctatus*, Bell) differs considerably in its habits from the great water newt. It is much more terrestrial, frequenting damp places, and is often found in cellars and underground vaults. Shaw, indeed, in his 'General Zoology,' asserts that the common newt is altogether a terrestrial species, and contradicts the statement of Linnæus that during its tadpole condition it inhabits the water; he says, "I can safely affirm that I have met with specimens in perfectly dry situations so extremely minute as scarcely to equal half an inch in length, which appear to differ in no respect, except in magnitude, from the full-grown animal." We have seen the same in damp cellars in abundance, and whatever difficulties there may be in accounting for their presence in such situations, they had doubtless been previously in a tadpole condition, from which they had recently emerged. It is a query, however, whether they require as much water as the other species, and whether they will not undergo their change in extremely humid spots, where water trickles freely about, and occasionally gushes up, as well as in ponds or ditches; certainly the specimens we have seen could not have crawled many yards; they were pallid, and slow in their movements. The common water newt is found in clear ponds and ditches; in the spring, the males appear ornamented with a continuous membranous crest from the head down the back to the end of the tail; this crest they lose in the month of June or July, when both adults and young quit the water for the land, where they creep about, lodging in damp places, under stones, and in crevices of the ground. Early in the winter, the crest of the male reappears, and is complete in the beginning of the spring, at which time he assumes a richer colouring. Aquatic insects and their larvæ, worms, &c., constitute the food of this species. The female deposits her eggs much in the same manner as already described, generally within a folded leaf, but not unfrequently at the junction of the leaf with the stalk. Mr. Bell states that he has sometimes seen the females in the act of placing their eggs not only singly, but by two, three, and four together.

In the common newt, the skin is smooth; on the head there are two rows of pores, but none on the back or sides. The crest of the male is not only much developed in the spring, but the margin is crenate, the tips of the crenations being sometimes tinged with fine red, sometimes with violet; the general colour above is yellowish or brownish grey, bright orange below, and everywhere marked with dark spots, some of an irregular figure. The female is yellowish brown, with scattered spots, and without the rich orange of the under surface. The upper lip is quite straight. Length, nearly four inches.

The Straight-lipped Water Newt (*Triton Bibronii*, Bell) differs from the great water newt in having the upper lip perfectly straight, and not over hanging the lower at its sides. Its skin also is more rugous and strongly tuberculated, and its colour darker. Habits the same as in T. cristatus.

The Palmated Water Newt (*Lissotriton palmipes*, Bell) is allied to the common water newt, from which it differs in having the upper lip pendulous at the sides, and the toes of the hind feet fringed permanently by a short membrane, which is seen in the male of L. punctatus only during the breeding season.—(See Fig. 2339—*a*, the Male; *b*, the Female.) It is also of a larger size, and the spots are more numerous and definite. The head also is marked with brown longitudinal lines; like the common species, however, which it resembles in its habits, it is liable to some variations of markings.

These animals are provincially termed efts, and askers. The power which the Salamandridæ possess of renewing the limbs and the tail when removed, and that repeatedly in succession, is very surprising. According to Bonnet, the reproduction of these parts is favoured by heat, and retarded by cold; in one instance after the total extirpation of an eye, the organ was reproduced, and perfect in its structure at the end of a year. Dufay has recorded their faculty of remaining frozen in ice for a long period without perishing. Though we mention these experiments, which are not without their physiological importance, we would distinctly state that their repetition for mere curiosity must be condemned as wanton and unpardonable cruelty.

2345.—The Spotted Salamander

(*Salamandra maculosa*). Spotted Land-Newt. *a*, the Head in profile.

In the genus Salamandra, the head is thick; the eyes large; the gape of the mouth ample; the tongue broad; the palatine teeth arranged in two long series; the parotid glands large; the body sprinkled with many small glands.

Unlike the aquatic newts the salamander is ovoviviparous, producing living young, which however at first inhabit the water and there undergo the same changes as do the Tritons: after the completion of which they crawl upon the land, frequenting humid places, and making their retreats among decayed timber in wooded districts in ditches, shaded spots, and crumbling ruins. In its habits it is sluggish and inert, and at the same time timid and retiring; it is impatient of the heat of the sun, and seldom leaves its lurking-place, except during rainy weather, or during the night. Its food consists of slugs, insects, and worms. As it increases in size it sheds its cuticle, which is moulted in flakes, as was observed by Dr. Barton. During the winter it hybernates in some hollow tree, or under stones or piles of wood, re-appearing in the spring. From the tuberculous glands of the skin exudes a milky glutinous fluid of an acrid nature like that of the toad, and which is evidently a defence against enemies; amongst which may be mentioned snakes and large lizards. To try the effects of this fluid, Laurenti provoked two grey lizards (Lacerta muralis) to bite a salamander, when the latter ejected from its pores some of this fluid into their mouths; one of the lizards died instantly, the other became convulsed and died at the end of two minutes. Some of the fluid was introduced into the mouth of another lizard, which became convulsed, was paralytic on the whole of one side, and soon died. When the animal is irritated this fluid is secreted in large quantities, and is ejected, according to Dr. Barton, to some distance. There is no reason to believe that such animals as dogs would die from the effects of this fluid in their mouths, though, as it is highly acrid, they might suffer more than from the toad.

Such then are the characters of this animal, the dreaded salamandra, which the ancients regarded with the utmost horror and aversion. They believed its bite to be certainly mortal; that anything touched by its saliva became poisonous, that whoever swallowed one, or any part of the animal, would instantly expire; nay, that if it crept over a fruit tree, all the fruit became deleterious, and that even herbs on which the fluid might fall would, if eaten, produce the most distressing effects. This fluid moreover was thought to cause the hair of the head to fall off. To crown all, the salamander was reported not only to be capable of resisting the effects of fire, but of extinguishing the fire itself, against which it would rush as against an enemy. Aristotle, Ælian, Nicander, Dioscorides, and Pliny, all support this opinion with their authority, and portray the salamandra both as a most deadly creature and also as incombustible.*

When a belief however erroneous becomes current it is with difficulty eradicated; hence are we not surprised that the marvellous powers attributed to this reptile by the superstitious Greeks and Romans continued to be received and propagated as facts, through the middle ages and almost to the present time; nor can we wonder that the alchymist should consider so potent a creature influential in his operations. It was in fact considered as having the property of transforming quicksilver into gold, and for this purpose it was secured in a vessel, and placed upon the fire, while the quicksilver was poured through an iron tube upon it; an experiment by which the life of the operator was thought to be placed in the utmost peril.

Cloth made of the skins of the salamander was formerly believed to be incombustible, and materials said to be of such manufacture were seen by Marco Polo, who however discerned that these fireproof cloths were made of a mineral substance; and we know that asbestos was termed salamander's wool by the old writers. Of such substance we believe will the salamander cloth, which we occasionally read of, be found to have been composed.

The spotted salamander is common in France, Italy, and the middle and southern countries of Europe generally, and probably the adjacent parts of Asia. In Gascony it is termed Myrtil, in Savoy Pluvine, in Maine Un Sourd. Its colour is black with yellow spots and numerous tubercles along the sides. There are several other species.

Fig. 2346 represents the Skeleton of the Salamander; *a*, the Skull seen in profile; *b*, seen from below.

The comparison of this skeleton with those of Menopoma, Sieboldtia, and that of the great Fossil Newt (Andrias Scheuchzeri), proves the close alliance between them. Fig. 2347 exhibits the Skull of Menopoma; *a*, seen in profile; *b*, seen from above; *c*, seen from below. Fig. 2348 is the Skull of Sieboldtia seen from below. Fig. 2349 several of the Vertebræ of Sieboldtia; and Fig. 2350, the Fore-hand of Sieboldtia. Figs. 2351 and 2352 represent the Fossil Relics of Andreas Scheuchzeri.

In a work like the present minute anatomical details would be out of place. To those, however, who may be interested in the subject we recommend the "Odontography" by Professor Owen. In that splendid work is an interesting chapter on the teeth of the batrachians, in which the affinities of structure presented by the reptiles in question are thoroughly investigated. A comparison of the figures we have given will convey to our intelligent reader a definite impression as to the proximity of the animals in question.

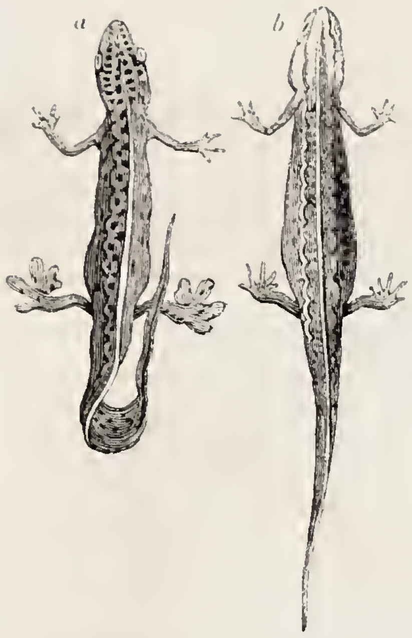
2353.—The Menopome

(*Menopoma Alleganiensis*, Harl.). Abranchus, Harl.; Protonopsis, Barton; Cryptobranchus, Leukardt and Fitzinger; Salamandrops, Wagler.

This animal is the Tweeg of the Indians. Helbender Mud Devil, Ground Puppy, and Young Alligator of the Anglo-Americans; Fisch Salamander of the Germans. Referring to the figure, *a* represents the mouth open, showing the tongue and teeth. Fig. 2354 is the upper surface of the head of the Menopome in outline.

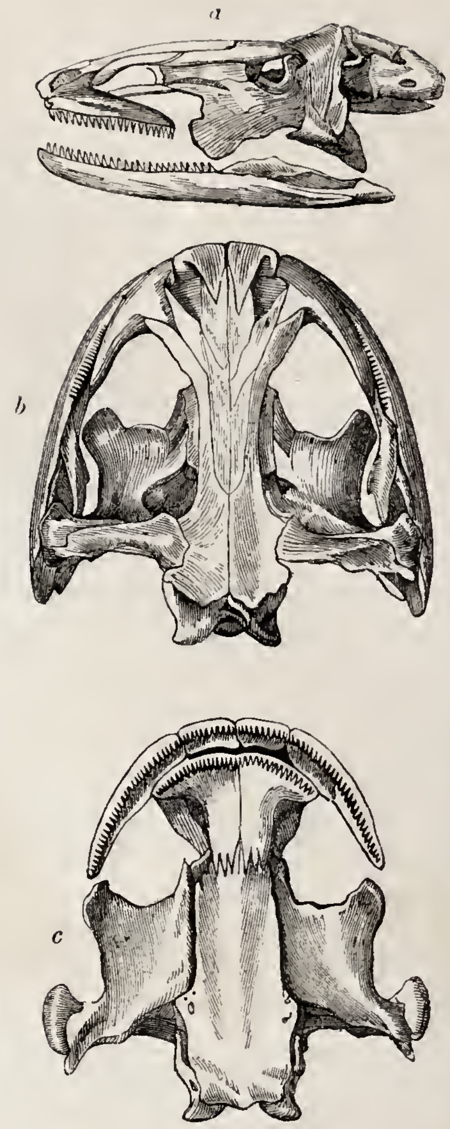
In this species, the only known representative of the genus, the head is flat and broad; there are two concentric rows of teeth in the upper jaw; the inner row are palatine; on each side of the neck is an operculum (probably the relic of the branchial apparatus and opening), situated about halfway between the angle of the mouth and the foreleg. There are here three opercular cartilages, and the aperture is between the posterior two. The limbs are short and thick, and fimbriated on the outer edge; toes four on the anterior feet, five on the hinder; the tail is laterally compressed; a fold of puckered skin runs down each side of the neck and body. This animal, which is about two feet in length, is a native of the Ohio and Alleghany rivers; Michaux appears to have been the first traveller who noticed it. He states that in the Torrents of the Alleghanies is found a species of salamander, termed by the inhabitants Alligator of the Mountains, and that some are two feet in length. In its habits this animal is extremely fierce and voracious, sparing nothing that it can overcome and devour. It is believed by the fishermen to be poisonous, and is consequently much dreaded; so revolting indeed is its aspect, that we can little wonder at their feelings

* We must except Galen, who knew that the reptile would burn; and we may add that Matthiolus, a commentator on Dioscorides, saw one destroyed by fire. He lived in the 16th century.



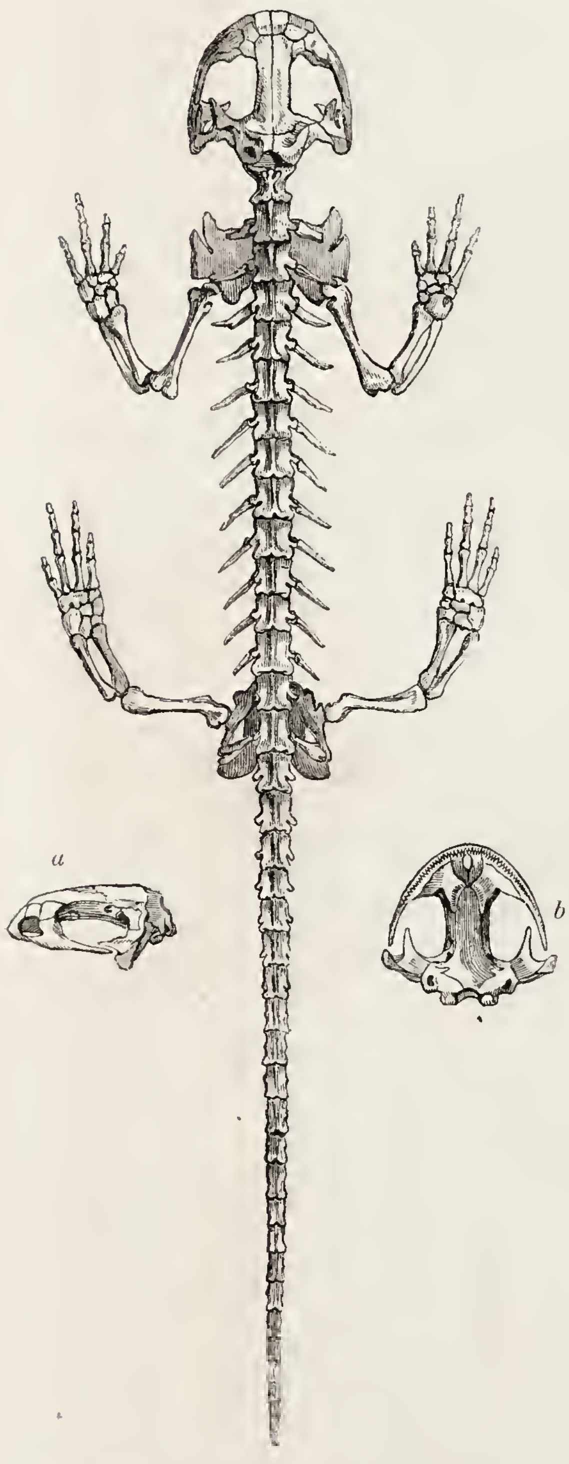
2339.—Common Smooth Newts.

2344.—Last stage of Young Water Newt.



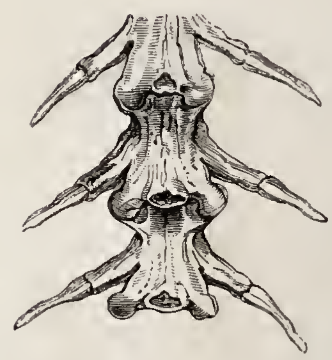
2347.—Skull of Menopome.

2350.—Fore-hand of Sieboldtia.



2346.—Skeleton of Salamander.

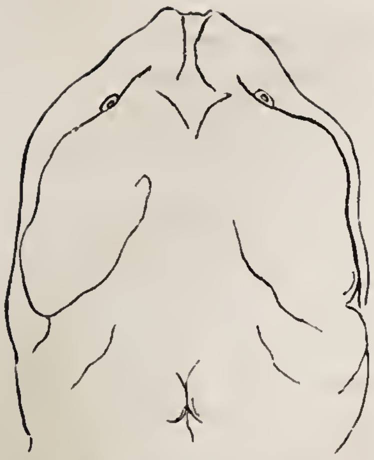
2345.—Spotted Salamander.



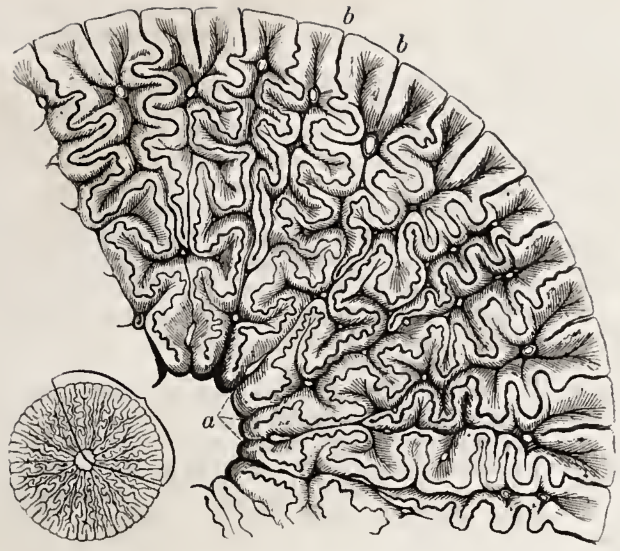
2349.—Vertebræ of Sieboldtia.

2348.—Skull of Sieboldtia.

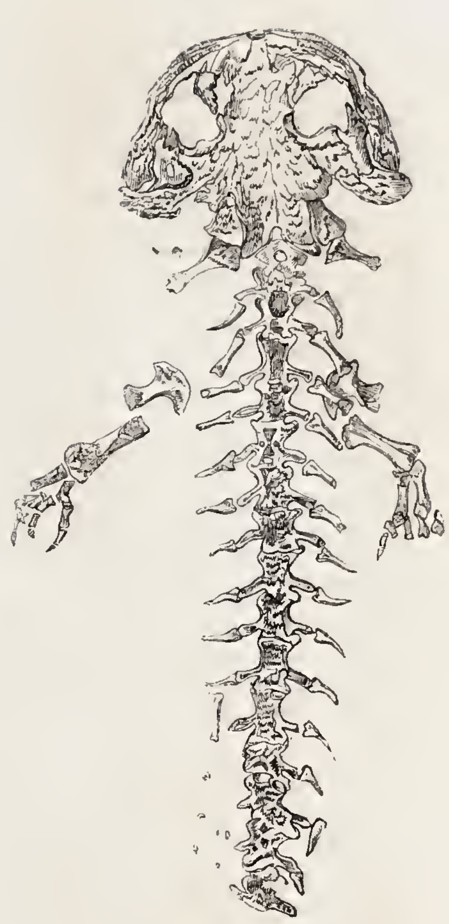
2353.—Menopome.



2354.—Head of Menopome.



2355.—Tooth of Labyrinthodon.

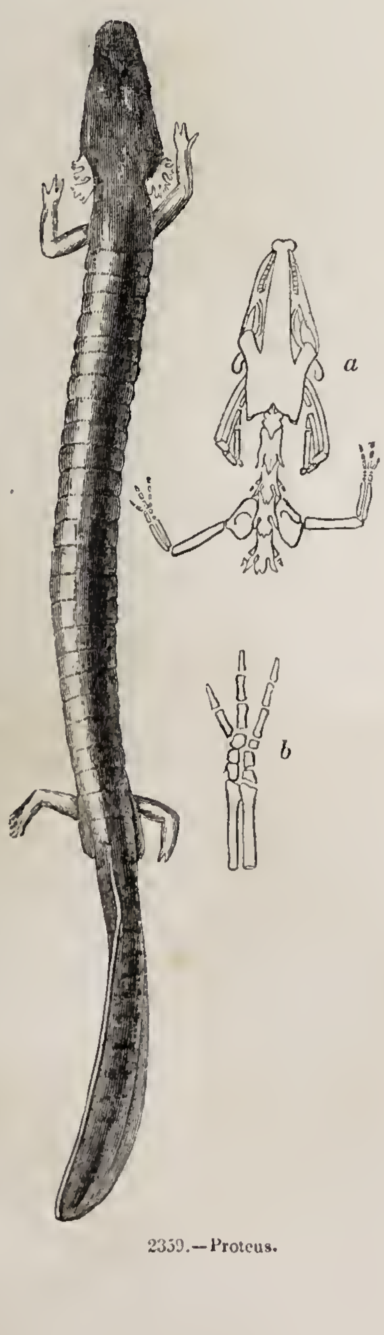


2351.—Great Fossil Salamander.

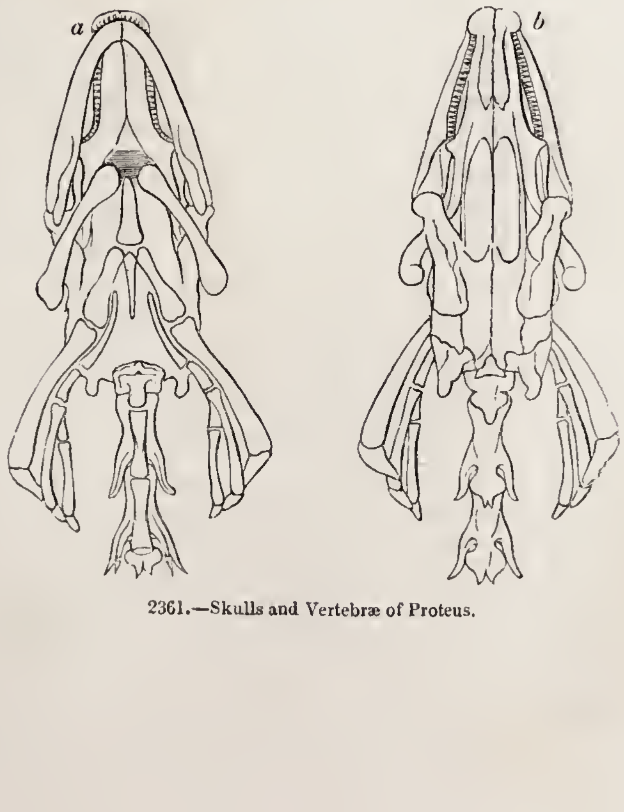
2358.—Three-toed Amphiuma.

2356.—Fossil Relics of Labyrinthodon.

2357.—Footprints of Labyrinthodon.



2359.—Proteus.



2361.—Skulls and Vertebræ of Proteus.

2352.—Great Fossil Salamander.

of dislike and apprehension. Much in its history yet remains to be cleared up; we know nothing of its tadpole state or of its transformations. Its general colour is slaty, with dark spots, and a dark line through the eyes.

With respect to the Sieboldtia maxima of the Prince of Canino (Megalobatrachus, Tschudi; Cryptobranchus, Van der Hoeven), it may be described as a gigantic salamander, three feet in length, inhabiting a lake on a basaltic mountain in Japan, where the species was discovered by Dr. Von Sieboldt, who brought away two individuals, a male and female, but the former devoured the latter during the passage homewards; the survivor arrived in Leyden, where it was lately living, and perhaps is so still. It feeds on fishes. In this reptile, as in the true newts, the slits of the branchial apertures are closed, and not open as in Menopoma. In the Zool. Proceeds. for March 13, 1838, will be found the notice of a letter from M. Van der Hoeven respecting it, with some observations by Professor Owen.

2351, 2352.—THE GIGANTIC FOSSIL SALAMANDER (*Andrias Scheuchzeri*, Tschudi).

From the Sieboldtia we turn to the fossil relics of a closely allied species, which has been extinct for ages.

It was in the Philosophical Transactions for 1726, that Dr. Scheuchzer published a short account of a fossil received by him from the Œningen beds (the miocene period of Lyell), which he firmly believed to be that of a human being, and as such was it received by the naturalists of his day. It was the "homo diluvii testis," a rare relic of one of that accursed people buried by the flood, or, to use the words of Scheuchzer in his 'Physica Sacra,' "λείψανον maledictæ illius et aquis sepultæ gentis."

The ruling passion of this physician was to collect fossils which might be considered as evidences of the deluge; hence, carried away by his favourite theory, when he looked at the fossil in question, he forgot the osteology of the human body, or viewed the bones imbedded in the stone through the distorted optics of an excited imagination. In 1755, another specimen came into the possession of Gesner, and though he repudiated the idea of the relics being those of man, yet he fell into an error in attributing them to a species of fish (Silurus Glanis, Linn.). A third and more complete specimen, now in the British Museum, came into the hands of Dr. Ammann of Zurich, a figure of which was published by Karg in the 'Memoirs of the Society of Naturalists of Suabia,' and still under the idea of its being a fossil silurus. That this opinion was erroneous, Jäger demonstrated by placing a figure of the Silurus Glanis by the side of Karg's figure of the fossil, and at once dispelled the illusion. On looking at Karg's figure, Cuvier at once perceived that the characters were those of the Salamandridæ, an opinion which had been entertained by M. Kielmeyer and by Camper, who, as Jäger says, observed, in a letter to Burton, that a petrified lizard has been able to pass for an anthropolite (fossil man). In 1811, Cuvier visited Haarlem, and obtained permission to work upon the stone which contained Scheuchzer's "homo diluvii testis." He placed the skeleton of a salamander before the operators, who, as the chisel chipped away the stone, exposing the bones to view, beheld with delight the predictions of Cuvier verified. The remains were indeed those of a gigantic salamander, to which the Sieboldtia bears the nearest affinity.

From this fossil form among the Salamandridæ, we must now turn to another, namely the Labyrinthodon of Professor Owen (Salamandroïdes, Jäger; Mastodonsaurus, Phytosaurus, Chirotherium); and to render the subject clear, we shall first advert to Fig. 2355, a transverse section of the tooth of Labyrinthodon, with a portion of the same magnified. Premising that the reptilian remains in question occur in the Warwick sandstone, and in the Keuper of Germany, we shall take an extract from the 'Proceeds. Geol. Society of Lond.' for 1841.

"Before he proceeded to describe the fossils forming the immediate object of his paper, Mr. Owen showed that the genus Phytosaurus was established on the casts of the sockets of the teeth of Mastodonsaurus, and that the latter generic appellation ought not to be retained, because it recalls unavoidably the idea of the mammalian genus Mastodon, or else a mammilloid form of the tooth, whereas all the teeth of the genus so designated are originally, and for the greater number, permanently of a cuspidate and not of a mammilloid form; and because the second element of the word, saurus, indicates a false affinity, the remains belonging not to the Saurian, but to the Batrachian order of reptiles. For these reasons, and believing that he had discovered the true and peculiarly distinctive dental characters of the fossil, he proposed to designate the genus by the term Labyrinthodon.'

"The only portions of the Batrachian found in the Keuper of Germany which have hitherto been described, consist of teeth, a fragment of the skull, and a few broken vertebræ; and in the Warwick sandstone, of teeth only. In this memoir, therefore, Mr. Owen confined his attention to a comparison of the dental structure of the Continental and English remains."

Professor Owen then enters into the minutiæ of structural details, and concludes by observing that "if on the one hand geology has in this instance really derived any aid from minute anatomy, on the other hand in no instance has the comparative anatomist been more indebted to geology, than for the fossils which have revealed the most singular and complicated modification of dental structure hitherto known, and of which not the slightest conception could have been gained from an investigation, however close and extensive, of the teeth of existing animals."

Referring to the Fig. 2355, we may observe that the small circle shows a section of the tooth of Labyrinthodon Jaegeri, Owen, of the natural size; the other is a quarter of the same circle magnified; *a*, is the pulp-cavity from which the processes of pulp and dentine radiate; *b b*, the cement. From the tooth of Labyrinthodon, we may now pass to Figs. 2356 and 2357, the relics and foot prints of a species termed Labyrinthodon Pachygnathus. Impressions made by the footsteps of animals, ripple marks, and little pits formed by the drops of a heavy shower, have been found at different times on the surface of various strata of sandstone, both in this and other countries, as well as in beds of comparatively recent formation in various parts of the kingdom; for example, in Pembrokeshire, on making excavations for a dock at Pembray, the tracks of deer and large oxen were discovered on a layer of clay underlying a bed of peat, and also on the surface of the peat itself below a bed of silt, bones of the animals themselves occurring in the peat. We learn also from Dr. Buckland, that in excavations made for a harbour near Margam Burrows, on the east of Neath, footmarks of deer have been observed. With respect to ancient strata, tracks of tortoises have been found impressed on the sandstone in the quarry of Corn Cockle Muir, Dumfriesshire, as described in Trans. Royal Soc. Edin., 1828; and in 1831, Mr. G. P. Scrope found numerous foot-prints of small animals, probably crustacea, and ripple marks in the beds of forest marble near Bath. The impressions of birds' feet have been discovered on the surface of sandstone in the valley of the Connecticut, and fossil bones of birds have occurred in the strata of Tilgate forest, antecedent to the chalk formation. To come, however, to the foot-prints of the Labyrinthodon, or as it was provisionally termed by Kaup, the Chirotherium, from the supposed resemblance in the marks both of the fore and hind feet to those of a human hand, and which he thought might have been derived from some quadruped allied to the Marsupialia.

It was in Saxony at the village of Hesseburg near Hildburghausen, that these fossil footsteps were first discovered in several quarries of grey quartzose sandstone alternating with beds of red sandstone, nearly of the age of the red sandstone of Corn-Cockle Muir. Dr. Hohnbaum and Professor Kaup state that those impressions of feet are partly concave and partly in relief; the depressions are described as being upon the upper surfaces of the sandstone slabs, but the footmarks in relief are only upon the lower surfaces, and cover the depressions. In short, the footmarks in relief are natural casts formed in the subjacent footsteps as in moulds. On one slab, six feet long by five feet wide, many footsteps of more than one animal and of various sizes occur. The larger impressions, which seem to be those of the hind foot, are generally eight inches in length and five in width, and one was twelve inches long. Near each large footstep, and at a regular distance (about an inch and a half) before it, a smaller print of a fore foot, four inches long and three feet wide, occurs. The footsteps follow each other in pairs, each pair in the same line, at intervals of fourteen inches from pair to pair. The large as well as the small steps show the great toes alternately on the right and left side; each step makes the print of five toes, the first or great toe being bent inward like a thumb. Though the fore and hind foot differ so much in size, they are nearly similar in form.

But these footsteps are not confined to foreign lands, and within the last few years able observers have contributed largely to this interesting subject. Dr. Buckland thus sums up the evidence obtained in this country:—"Near Liverpool Mr. Cunningham has successfully continued his researches begun in 1838, respecting the footsteps of Chirotherium and other animals in the new red-sandstone at Storeton Hill, on the west side of the Mersey. These footsteps occur on five consecutive beds of clay in the same quarry; the clay-beds are very thin; and having received the impressions of the feet, afforded a series of moulds in which casts were taken by the succeeding deposits of sand, now converted into sandstone. The casts of the feet are salient in high relief on the lower surfaces of the beds of sandstone, giving exact models of the feet and toes and claws of these mysterious animals, of which scarcely a single bone or tooth has yet been found, although we are assured by the evidence before us of the certainty of their existence at the time when the new red sandstone was in process of deposition. Further discoveries of the footsteps of Chirotherium and five or six smaller reptiles in the new red sandstone of Cheshire, Warwickshire, and Salop, have been brought before us by Sir P. Egerton, Mr. J. Taylor, jun., Mr. Strickland, and Dr. Ward. Mr. Cunningham, in a sequel to his paper on the footmarks at Storeton, has described impressions on the same slabs with them, derived from drops of rain that fell upon thin laminæ of clay interposed between the beds of sand. The clay impressed with these prints of rain-drops acted as a mould, which transferred the form of every drop to the lower surface of the next bed of sand deposited upon it, so that entire surfaces of several strata in the same quarry are respectively covered with moulds and casts of drops of rain that fell whilst the strata were in process of formation. On the surface of one stratum at Storeton, impressed with large footmarks of a Chirotherium, the depth of the holes formed by the rain-drops on different parts of the same footstep has varied with the unequal amount of pressure on the clay and sand, by the salient cushions and retiring hollows of the creature's foot; and from the constancy of this phenomenon upon an entire series of footmarks in a long continuous track, we know that this rain fell after the animal had passed. The equable size of the casts of large drops that cover the entire surface of the slab, except in the parts impressed by the cushions of the feet, record the falling of a shower of heavy drops on the day in which this huge animal had marched along the ancient strand: hemispherical impressions of small drops, upon another stratum, show it to have been exposed to only a sprinkling of gentle rain that fell at a moment of calm. In one small slab of new red sandstone found by Dr. Ward near Shrewsbury, we have a combination of proofs as to meteoric, hydrostatic, and locomotive phenomena, which occurred at a time incalculably remote, in the atmosphere, the water, and the movements of animals, and from which we infer, with the certainty of cumulative circumstantial evidence, the direction of the wind, the depth and course of the water, and the quarter towards which the animals were passing; the latter is indicated by the direction of the footsteps which form their tracks; the size and curvatures of the ripple-marks on the sand, now converted to sandstone, show the depth and direction of the current; the oblique impressions of the rain-drops register the point from which the wind was blowing at or about the time when the animals were passing."

The Address from which the above passage is taken was delivered at the anniversary of the Geological Society of London on the 21st February, 1840; and at that time all was conjecture as to the nature of the animal called Chirotherium. Professor Owen's paper, read on the 20th January, 1841, proved the existence of a gigantic Batrachian at the period when the new red sandstone was formed. Scarcely was that memoir communicated, when additional materials of the highest importance were brought forward by the liberal possessors of them, and the result was a second paper, read before the Geological Society of London on the 24th of February, in which three species of Labyrinthodon were defined, and evidence relating to the ichnology* of those extinct Batrachians was adduced, which may be briefly stated as follows:—

1st. Proof from the skeleton that Labyrinthodon had hind extremities much larger than the anterior extremities.

2nd. That the foot prints of Chirotherium are at least as much like those of certain toads as those of any other animals.

3rd. That the size of the known species of Labyrinthodon corresponds with the size of the foot-prints of the different species of Chirotherium: *e. g.* Labyrinthodon Jaegeri, with the footprint of Chirotherium Hercules (Egerton); Labyrinthodon pachygnathus, with the foot-marks of the common Chirotherium; and Labyrinthodon leptognathus, with the impressions of the smaller batrachian figured in the memoir by Mr. Murchison and Mr. Strickland.

4th. Labyrinthodon occurs in the new red sandstone strata to which Chirotherian impressions are peculiar. And

Lastly, no remains of animals that could have left such impressions as those of the Chirotherium have been found in these strata, except the remains of the Labyrinthodons.

* Ἴχνος, a footstep; λόγος, a discourse.

The reading of Professor Owen's last memoir was accompanied by the exhibition of a diagram representing a restoration of two species of Labyrinthodon, one of which, L. Pachygnathus, is copied on a greatly reduced scale; Fig. 2356 and 2357. The bones which appear within the outline are those which were known when the paper was read. The animal is represented as impressing its footsteps on a shore of sand, now new red sandstone. There is reason for believing that this formidable batrachian was not smooth externally, but that it was protected on certain parts at least by bony plates. Specimens of the footprints may be seen both in the British Museum and in the Museum of the Royal College of Surgeons, London.

Family AMPHIUMIDÆ (AMPHIUMA).

2358.—The Three-toed Amphiuma

(*Amphiuma Tridactylum*). Two species of Amphiuma only are known; they inhabit the stagnant pools and ditches of Louisiana, Georgia, Florida, and South Carolina, and great numbers are often found in clearing out ponds, buried deep in the mud at the bottom.

In these Amphibia, as in Menopoma, no Branchiæ have been found, but an orifice exists in each side of the neck, demonstrating their existence at some previous period. The body is extremely long, and covered with a smooth skin, which, together with their general form, gives them an eel-like appearance; the limbs are four in number, but extremely minute; in one species the toes on each limb are three in number, in the other only two; they are little jointless divisions. There are no ribs, and the vertebræ resemble in their structure those of fishes; the eyes are very small; there are two longitudinal ranges of palatal teeth. These animals are essentially formed for the water, where they obtain their prey; on the approach of winter they bury themselves in the mud and there hybernate, occasionally however they creep on land, and burrow in spongy places, or under decaying logs, or fallen trunks of trees in swamps and marshes. Dr. Harlan, speaking of the small two-toed species, says "I am informed by Major Wace, that they are sometimes discovered two or three feet under mud of the consistence of mortar, in which they burrow like worms, as was instanced in digging near a street in Pensacola, where great numbers were thrown up during the winter season. It is called in Florida the congo snake by the negroes, who believe it to be poisonous, but without foundation.

The three-toed amphiuma attains the length of three feet; the two-toed is only about eighteen inches long.

We may now pass to the Perennibranchiate Amphibia, in which while the lungs are developed the branchiæ remain, whence the animals are capable of respiring both air and water.

Family PROTEIDÆ (PROTEUS, AXOLOTL, &c.).

2359, 2360.—The Proteus

(*Proteus anguinus*, Lawr.) Hypochton anguinus, Merrem.

This curious animal, interesting alike from its structure and extraordinary abode, has greatly excited the attention of scientific men, who have diligently investigated its structure. We may describe it as a slender, elongated reptile, with a smooth and delicate skin, with a compressed tail, with a depressed head, and with four short feeble and almost useless limbs. The mouth is wide, and the jaws are armed with teeth; the eyes are mere rudimentary points covered by the skin; the fore-limbs are furnished with three toes, the hind-limbs with two. The branchiæ or gills are exposed, and form two pink tufts, one on each side of the occiput. The movements of the animal are eel-like. Deep under ground, in subterranean waters, where no ray of light ever penetrates, does the Proteus dwell; light, indeed, is too great a stimulus for the creature to bear: we have had opportunities of observing these singular animals in confinement, and always noticed, that they shrouded themselves in the darkest part of the vessel in which they were placed, when the covering was taken off in order to inspect them; and that they betrayed a sense of uneasiness by their actions, when exposed to the light of open day, creeping round the sides of the vessel, or under the shelter of any substance which threw a partial shadow on the water. Their colour was that of pale flesh; but after a short exposure to light, the skin assumed a darker tint, and the branchial tufts became of a deeper red.

Though these animals lived many months, and were healthy and vigorous, they were not supplied with any food, nor know we on what they subsist, though we have every reason to believe them carnivorous.

It is from two or perhaps three localities only that the Proteus has been obtained. At Adelsburg, in the duchy of Carniola, belonging to Austria, there is one of the most extraordinary caverns in Europe, extending many hundred feet below the surface, termed the Grotto of the Maddalena. The district around this cavern consists of bold rocks and mountains of limestone formation. Beneath these, at an enormous depth, are subterranean cavities, and immense reservoirs of water, buried lakes, whence many rivers take their secret origin; and it is from this vast reservoir that a small lake in the grotto of Maddalena is supplied, a lake in pitchy darkness, on which no sunbeam ever plays, enclosed by awful masses of rock, with rifts and chasms on every side, and above a canopy of drooping stalactites. On the soft mud below the water of this little lake, these singular creatures may be seen moving like small eels, endeavouring to escape the unnatural glare of torch-light. It is not here, however, that the Protei are bred, nor are they always to be found, and it is only after great rains that they are abundant. Besides this cavern at Adelsburg, where they were first discovered by the late Baron Zöis, they have been found, though rarely, at Sittich, thirty miles distant, thrown up by water from a subterranean cavity, and Sir H. Davy says: "I have lately heard it reported that some individuals of the same species have been recognised in the calcareous strata of Sicily." With regard to their original abode, we agree with the same eminent writer; his words are, "I think it cannot be doubted that their natural residence is in an extensive deep subterranean lake, from which in great floods they are sometimes forced through the crevices of the rocks into this place where they are found; and it does not appear to me impossible when the peculiar nature of the country is considered, that the same great cavity may furnish the individuals which have been found at Adelsburg and at Sittich."

Many have entertained the idea that these animals are tadpoles, or the larvæ of some unknown creature inhabiting the subterranean waters; this idea is, however, sufficiently proved to be incorrect: they are perfect animals with gills and lungs. "This animal is, I dare say, much larger than we now see it, when mature in its native place, but its comparative anatomy is exceedingly hostile to the idea that it is an animal in a state of transition. It has been found of various sizes, from the thickness of a quill to that of the thumb, but its form of organs has been always the same. And it adds one instance more to the numbers already known of the wonderful manner in which life is produced and perpetuated in every part of our globe, even in places which seem the least suited to organized existences.

Referring to Fig. 2359, *a*, represents the Skull, half the natural size; *b*, the bones of the Fore-foot. Fig. 2361 represents the Skull of the Proteus and three first vertebræ—*a*, as seen from below; *b*, as seen from above. Fig. 2362 represents the Skeleton of the Proteus—*a*, the Bones of the Fore-foot; *b*, the Bones of the Hind-leg.

2363.—The Striated Siren

(*Siren striata*.)

The Sirens are eel-like animals utterly destitute of hinder limbs, and the fore-limbs are reduced to small feeble rudiments, with four or three toes. There are three plumed gill-tufts on each side; the head is small and flattened, the muzzle blunt; the eye is minute. There are ranges of teeth on the palate; the lower jaw is furnished with teeth, but not the upper. The vertebræ, which are very peculiar in form, have their articular faces hollow and united by cartilages, in the form of a double cone as in fishes.

Fig. 2364 represents the Skeleton of Siren lacertina. Fig. 2365 the Head and Fore-limb—*a*, one of the dorsal vertebræ seen behind; *b*, the same seen before.

Of these animals, three species appear to be known, viz.: Siren lacertina, S. intermedia, and S. striata. The Lacertine Siren grows to the length of three feet, and has four toes on each foot. It inhabits the marshy grounds of Carolina, especially those where rice is cultivated, and lives in the mud, or muddy water, and occasionally crawls on the dry ground. Worms and insects are its food, but Dr. Garden, who discovered it in 1765, and sent a specimen to Linnæus, asserts that it will devour snakes, and also states that it utters a sound like the voice of a young duck; both these points, however, are denied by Barton; its colour is blackish.

In 1841, a lively specimen was living in the Zoological Gardens. It was kept in a vessel of pond-water, with a deep bottom of mud, in which it buried itself; it fed upon earth-worms, devouring a dozen and a half every other day. It was about twenty inches long, and very eel-like in all its movements.

The Siren striata is a small species, about nine inches long, with three toes only on each foot. It is of a blackish colour, with two longitudinal yellow stripes down each side. At Fig. 2363, *a* shows the Head, Branchiæ, and Fore-foot.

According to the testimony of various microscopic observers (Professors Wagner, Van der Hoeven, Owen, &c.), the magnitude of the blood globules in the perennibranchiate amphibia is very extraordinary. In the Proteus, indeed, they may be observed by the naked eye; in the Siren, as observed by Professor Owen, they are also very large, forming a great contrast to those of higher reptiles, birds, and mammalia. Fig. 2366 shows a comparison by Professor Owen, of the blood-discs of Man and the Siren, drawn by the Camera lucida under a magnifying power of seven hundred linear dimensions. *a*, Human Blood-discs; *a'*, the same viewed edgewise; *b*, Siren's Blood-discs; *b'*, the same viewed edgewise; *c*, Folds of External Capsule, produced by desiccation; *d*, Capsule of Nucleus; *e*, Nucleoli.

2367.—The Necturus

(*Necturus lateralis*, Rafinesque). Menobranchus lateralis, Harlan; Phanerobranchus lateralis, Fitzin.

In the genus Necturus (Menobranchus, Harlan) the body is moderately elongated, the tail flattened at the sides, the branchial plumes large; there is a row of palatal teeth, and a parallel but more extensive row of maxillary teeth. The limbs are four in number, very small, with four toes each.

The Necturus lateralis inhabits the great lakes of North America, and attains to the length of two or three feet. Its general colour above is olive with blackish dots; a line along the muzzle blackish; under-parts blackish, variegated with spots of olive. Of its habits little is known.

2368, 2369.—The Axolotl

(*Siredon pisciformis*, Wagler). Siren pisciformis, Shaw; Gyrinus edulis, Hernandez; Menobranchus pisciformis, Harlan.

This fish-like amphibian is remarkable for the three long fringed processes on each side of the neck, forming conspicuous gill-tufts. The limbs are four; the anterior are furnished with four toes, the hinder with five; there are teeth in both jaws as well as palatal teeth, aggregated in numerous rows, and rasp-like, as in certain fishes; the tail is compressed at the sides like that of a water newt, and furnished above and below by a membranous fin; the muzzle is blunt, and the eyes are small.

Referring to Fig. 2369, the sketch accompanying the figure represents the Under Jaw and Throat of the animal as seen from beneath, in order to show the singular form of the gills. At Fig. 2368—*a*, represents the Mouth open, and viewed in front, to show the teeth.

The Axolotl is a native of Mexico, and common in the lake surrounding the city of that name; and according to Baron Humboldt is also found in cold waters of mountain lakes at a much greater elevation above the level of the sea than the plain in which the city of Mexico is situated. This animal is commonly sold in the markets of that city, and is esteemed a luxury by the inhabitants; it is dressed after the manner of stewed eels, and served up with a rich sauce. Hernandez says that it is agreeable and wholesome. For a long time the Axolotl was regarded as the tadpole or larva of some unknown batrachian, and was so regarded by Cuvier, till he prepared the last edition of his 'Règne Animal,' and even there he seems to retain a degree of doubt respecting it. His words in a note are "Ce n'est encore qu'avec doute que je place l'Axolotl parmi les genres à branchies permanentes; mais tant de témoins assurent qu'il ne les perd pas, que je m'y vois obligé."

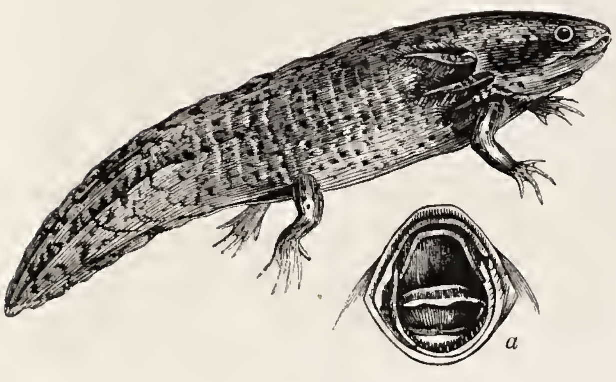
Repeated observations, however, have fully established the fact that the Axolotl is truly a perennibranchiate amphibian: Humboldt, in his "Observations de Zoologie," has entered into minute details of its anatomy.

The length of the Axolotl is eight or ten inches: the general colour is uniform deep greyish brown, everywhere thickly mottled with small round black spots. The communications which open from the gills into the mouth are four in number and of a size considerably larger than in the allied genera. They are covered externally by a species of operculum formed by a fold in the skin of the head.

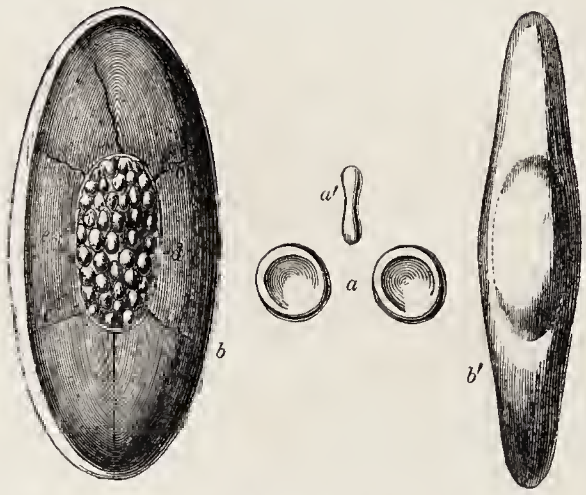
END OF THE CLASS REPTILES.

2360.—Proteus.

2262.—Skeleton of Proteus.

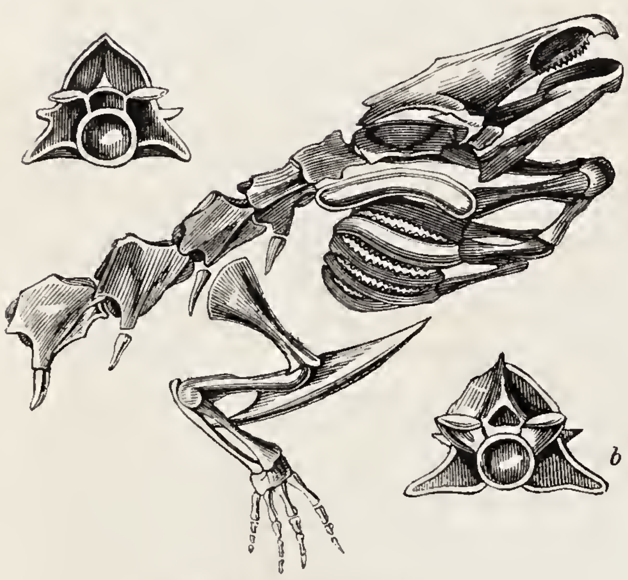


2368.—Siredon, or Axolotl.



2366.—Blood discs of Man and Siren.

2367.—Necturus.

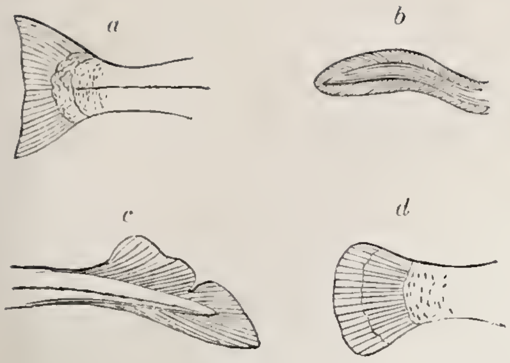


2365.—Head, &c. of Striated Siren.

2363.—Striated Siren.

2364.—Skeleton of Striated Siren.

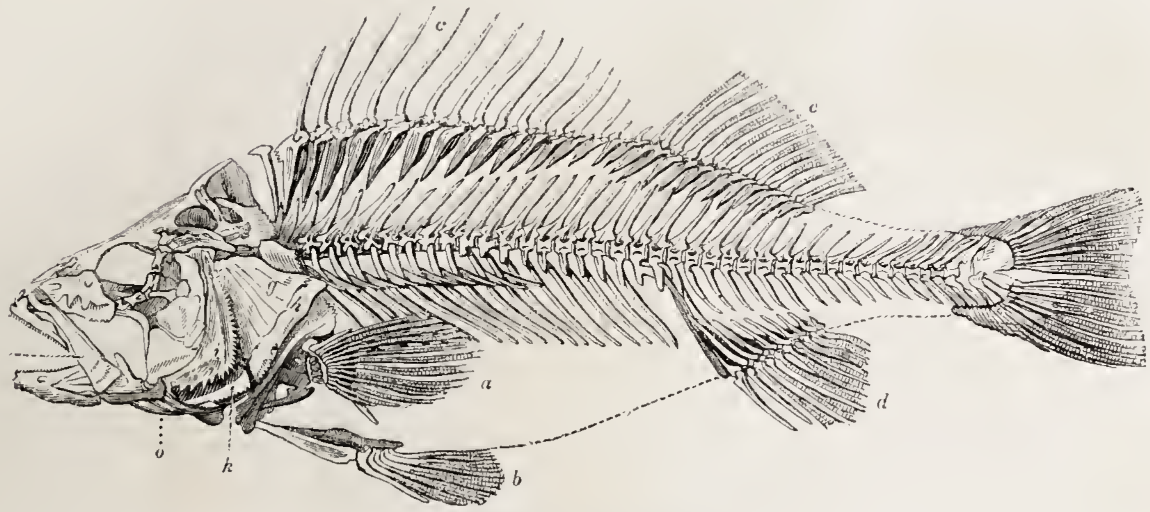
2369.—Siredon, or Axolotl.



2374.—Tails of Fishes.

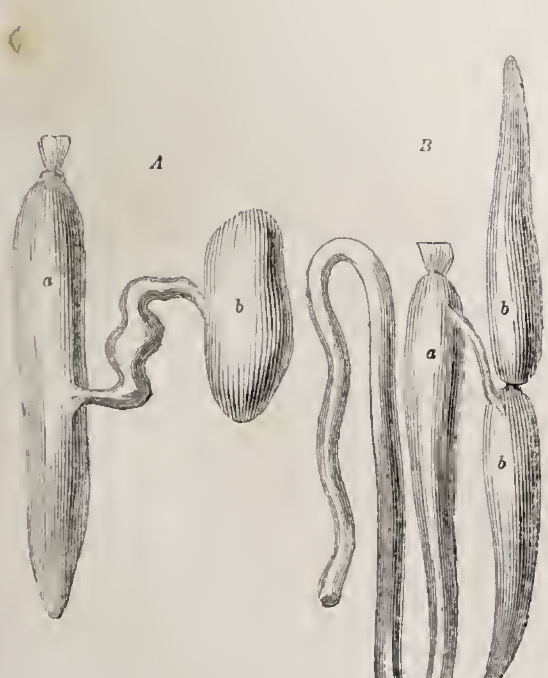
2370.—Lepidosiren.

2377.—Group of Fishes.



2373.—Skeleton of Perch.

2371.—Natives of Nootka Sound.



2372.—Swimming bladders of Dace and Conger-Eel.

2375.—Jaws of Trout.

2376.—Depths of the Sea.

CLASS PISCES (FISHES).

Before we enter at large upon the present class, we must call attention to a singular form, Lepidosiren, which by some naturalists is referred to the Perennibranchiate Amphibia, and by others to the fishes.

It was in the year 1837 that Professor Natterer obtained two specimens, one found in a swamp on the left bank of the river Amazon in South America, the other taken in a pond near Borba, on the river Madeira, a tributary to the Amazon. The description of these was published in the 'Annals of the Museum of Vienna,' under the title of "Lepidosiren Paradoxa." In the same year an allied species was presented to the Royal College of Surgeons by Thomas C. B. Weir, Esq., together with a smaller dried specimen enclosed in indurated clay baked hard in the sun; it was brought from the river Gambia in Africa; and under the generic title of Protopterus was described by Professor Owen in the MS. catalogue of the Museum R. Coll. S., and more fully in the 'Linnean Trans.' (vol. xviii. pt. 3, p. 327), under the title of Lepidosiren annectans, the generic term proposed by Dr. Natterer being adopted. Of this species from Gambia Fig. 2370 is a representation.

In both species the body is fish-like, and covered with scales; there are mucous pores and ducts upon the head, and a series of pores around each eye, whence the lateral line, seen in fishes, commences; the muzzle is obtuse; the branchial apertures are narrow vertical slits; the eyes are small; the nostrils are situated at the under part of the upper lip (which is fleshy), and lead, as in fishes, to two sacs, which have no communication with the mouth, and are not respiratory organs; there are two slender, sharp pointed, recurved teeth in the intermaxillary bone, and the alveolar border of both the upper and lower jaws is armed with a strong trenchant dental plate, soldered to the bone, and divided at the middle line, so as to form two distinct portions above, and two below; each of these portions is twice indented, so as to present three angular acute processes, adapted for piercing; and the strength of the jaws, and size of the muscles which work them, prove that they are efficient instruments. There are no palatal teeth. The limbs are represented by four tentacular appendages, many-jointed in the African species, not jointed in the American. A dorsal fin, supported by numerous soft elastic transparent rays, commences about one-third of the distance from the head, and runs to the extremity of the tail, which is furnished underneath with a similar fin; but there is no expanded caudal fin as in fishes generally. The skeleton is partly cartilaginous, partly bony, and the osseous portions are of a green colour as in the Gar-fish.

With branchiæ or gills approaching in structure those of the Perennibranchiate amphibia, the Lepidosiren also possesses lungs, and, as there is reason to believe, breathes, occasionally at least, atmospheric air. In some specimens of the African Lepidosiren two minute tentacles accompany each of the pectoral or anterior ones. The heart possesses a double auricle in the South American species, and the skeleton is more cartilaginous.

The Lepidosiren paradoxa from South America attains to a considerable size; one of Dr. Natterer's specimens measured upwards of three feet in length, and the other nearly two.

The Lepidosiren annectans from the Gambia does not much exceed a foot in length. The specimen, a female described by Professor Owen in the 'Linn. Trans.' vol. xviii. part 3, measured twelve inches eight lines. From the fish-like contour of these animals we may easily form an idea of their progressive motion through the water, and it is probable that the tentacular appendages may enable them to raise themselves upon aquatic plants, or even to crawl up the banks of the pond or river.

In a notice respecting these singular creatures by Sir W. Jardine, in the 'Ann. and Mag. of Nat. Hist.,' March, 1841, p. 25, he says, in reference to the African species:—"If the structure of this animal is remarkable, so also are some habits in its economical history; but we have to regret that our history on these points is still very imperfect."

Miss Weir, in allowing us to examine the specimens of the fish, accompanied them with the following note, and a piece of the hard clay, alluded to in the 'Trans. Linn. Soc.,' bearing the impression of the animal, as if it had lain for some time imbedded in it, and with the earth in such a state as to allow the form of the cast to be retained. "Fish taken in the summer of 1835 on the shore of Macarthy's Island, about three hundred and fifty miles up the river Gambia. They were found about eighteen inches below the surface of the ground, which, during nine months in the year, is perfectly dry and hard; the remaining three months it is under water. When dug out of the ground and put into water the fish immediately unfold themselves and commence swimming about. They are dug up with sharp stakes, and are used for food."

A specimen folded up and enveloped in leaves, was among those examined by Sir W. Jardine. It seemed, he says, "to have been rolled up in dried leaves, or in leaves which might have accumulated at the bottom of the inundated ground; several adhered to it, and were kept in their place by means of a large supply of mucus, which still invested the specimen, and may serve as a provision to assist in preserving life during the torpidity or hybernation of the animal."

From these anomalous beings we pass on to the true Fishes.

The study of fishes, termed Ichthyology (ιχθυς a fish, λογος, a discourse or treatise), is not only very interesting but very important. Of all the classes of vertebrate animals, there is not one which affords so great a number of species useful as food to man. Nor is the supply scanty: they are drawn by millions from the deep; the work of the fisheries gives employment to thousands; the amount of property involved is enormous; and for the promotion and protection of this branch of traffic, legal enactments have been enforced, and societies incorporated. Without going into long details, let us look simply to the British Fisheries, and give one or two instances of the national importance of this source of wealth. We will take the herring, a fish used both in a salted and fresh state.

Year ending April 5.	Cured Barrels.	Branded Barrels.	Exported Barrels.
1832....	362,660	157,839	217,499
1833....	416,964	168,259	220,684
1834....	394,916	178,000	272,093
1835....	277,317	85,079	158.805
1836....	497,615	192,317	273,393
1837....	397,737	114,192	189,265

The number of boats and fishermen and other persons employed in taking, cleaning, curing, and packing cod and herrings, in each of the six years to April, 1837, were as follows:—

Year.	Number of boats.	Number of Fishermen.	Number of Coopers, Curers, &c.	Total Number employed.
1832....	11,059	49,164	31,402	80,566
1833....	11,008	48,181	33,274	81,455
1834....	11,284	49,212	33,054	82,266
1835....	11,359	49,462	32,861	82,323
1836....	11,427	49,720	37,178	86,898
1837....	11,494	51,907	34,626	86,533

During a favourable season 100,000 mackerel are brought to Billinsgate market every week; we say nothing of soles, turbot, whiting, haddocks, salmon, eels, &c., &c.; for want of space prevents our entering into details. But to turn from the fisheries of our own and other European nations, to how many tribes of savage people do not the magazines of the ocean afford the almost exclusive means of subsistence? Look, for instance, at the natives of Nootka Sound, and see the rude cabin stored with fish, dried and smoked, which with the roe prepared, and forming what Cook called their "bread," constitute their winter diet. (Fig. 2371.) We might easily add other instances, but it is needless; they will suggest themselves to our reader.

Tenants of the waters of our globe, the organization of these animals expressly fits them for their liquid element. They are clothed neither with hair nor feathers, but with smooth scales, often beautifully bright and delicate, giving uniformity of surface to a compact contour, admirably adapted for progress through the waters. Some, it is true, have a hard osseous envelope, as the Ostraceans; and others are arrayed in a panoply of spines, as the Tetraodons, and Diodons, which remind us of the hedgehog. There are some also, as the eel, the cod-fish, shark, &c., which have the skin naked, smooth, and slippery. As is the case with terrestrial animals, they vary in their habits and powers of locomotion: some move slowly along, others cleave the waves with the velocity of an arrow, bear up the rapids, and clear the falls with wonderful energy. Many persons regard the fins as the principal organs of locomotion in fishes, but these, in fact, are principally used as balancers of the body, as agents in turning the direction of the animal's course, or of guiding it as it swims along. It is the tail or elongated muscular extremity of the fish, tipped with a broad expanded web or fin, which constitutes the efficient organ of locomotion. The fish sculls itself along by rapid strokes from side to side, as may be seen by disturbing one of these animals while at rest and watching its actions. It is by the movements of the same organ, only more violently exerted, that the fish leaps out of the water, and springs at insects, or clears the waterfall; and we may further observe that it is only in such fishes as have the tail muscular and powerful, and the body compactly shaped, that this faculty of leaping exists. The large-headed, slender-tailed cod-fish cannot leap, but the salmon and trout will spring several feet above the surface of the water. The use of the fins as balancers was proved by the experiments of Boulli, who observed, that when both the ventral and pectoral fins of fishes were cut off, all their motions were unsteady, and they reeled from right to left, and up and down, in a very irregular manner.

In adverting to the movements of fishes, we must here notice that internal sac generally known under the name of the swimming bladder. This consists of a reservoir of air placed beneath the spine, and varying in form and size in different species; in some, as the perch, it is simple, and closed at both extremities; in the carp it is large, and divided into two portions: sometimes a communication exists between this sac and the gullet, or, as in the herring, between it and the stomach. The gas with which this sac is filled is generally found to be nitrogen; but in fishes that live at a great depth, the gas has been ascertained by MM. Configliachi and Biot to be chiefly oxygen. It is, according to the opinion of most naturalists, by the compression of this sac, that the fish is enabled to sink, the specific gravity of the body being altered by the degrees of contraction or expansion to which the sac is subjected. In many fishes, however, this swimming bladder is wanting, as in the red mullet, and the mackerel. Mr. Yarrell says, that one-fourth of the fishes known are without air-bladders, and that two-thirds of the other three-fourths have the air-bladder entirely closed, having neither canal nor aperture for external communication. Fig. 2372 represents the Swimming Bladder of two fishes.—A, the Dace; *a*, the Stomach; *b*, the Swimming-bladder: B, the Conger-Eel; *a*, the Stomach; *b*, the Swimming-bladder.

We need scarcely observe that fishes respire through the medium of water, by branchiæ or gills forming a series of vascular fringes supported by bones termed the branchial arches, generally four in number on each side. The water is taken in through the mouth and passed out over the gills so as to lave them thoroughly and oxygenate the blood. The gills are covered by a flap called the operculum or gill-cover, composed of four pieces, the præoperculum, the operculum par excellence, the suboperculum, and the interoperculum; besides these, there is a membrane supported by a row of slender bones springing from each branch of the os hyoides, so as to close the great fissure beneath. This membrane is called the branchiostegous membrane, and the slender bones the branchiostegous rays. The heart consists of one auricle and one ventricle.

The teeth of fishes in general are organs of prehension, and vary in form, number, and situation; often the whole of the inside of the mouth is armed with them; not only are the jaws furnished with them, but the palate, the pharynx, and the tongue itself. In the carp tribe, there are no teeth in the jaws, but there are pharyngal teeth, so disposed as to work upon a broad three-sided plate, supported by the basilar bone at the base of the skull, and by this is the aliment bruised before passing into the stomach. There are no salivary glands, and the sense of taste is not acute. The organs of smell are simple cavities which have no communication with the mouth, and are lined with a pituitary membrane variously folded, evidently to increase the extent of sentient surface over which the fibrils of the olfactory nerve are spread.

The sight of fishes is generally quick and accurate, and the eye is expressly organized for aquatic vision; the crystalline lens is large, dense, and globular, approximating to the flat cornea, the aqueous chamber being very inconsiderable, and the aqueous humour only sufficient to allow the free suspension of the iris. There are no eyelids. It cannot be doubted that fishes hear; they have, however, no external auditory apparatus, nor a tympanic cavity, but a labyrinth, viz. three semicircular canals, communicating with a vestibular cavity filled with a transparent glairy fluid, and enclosing certain hard bodies called otolithes, generally three in number, suspended by delicate filaments. We have said that fishes are usually covered with scales, differing in size and arrangement; one row of scales along each side, forming the lateral line, is generally

very conspicuous, each scale being pierced through near the centre by a tube, from which oozes a mucous secretion, the product of glands beneath; with this mucus the external surface is lubricated.

Among the external organs which afford characters for the discrimination of genera, families, and orders, the fins assume an important place; they differ in number and form, and have different names according to their situation. In some instances they are supported by slender pointed processes of bone, consisting each of a single undivided piece; such are called spinous rays. In other cases the rays consist of a number of minute parts united together, and often terminating in several filamentous branches; such rays from their pliant structure are termed soft or flexible rays. Two leading divisions in systematic arrangements are founded on this difference of structure.

Referring to Fig. 2373, the Skeleton of the Perch, the fins and some of the more important points of structure are lettered for the sake of clearness; *a* is the pectoral fin of one side; *b*, the ventral; *c*, *c*, are two dorsal fins, of which the first is supported by spinous rays, the second by flexible rays; *d*, the anal fin; *f* is the maxillary or upper jaw bone; *e* is the intermaxillary bone, a distinct bone from the maxillary; *g* is the operculum; *h*, the suboperculum; *i*, the præoperculum; *k*, the interoperculum; the fin terminating the body is called the caudal fin. Among existing fishes this is either simple, as in the eel; bifurcate, as in the salmon; expanded to a round figure, as in the wrasse; or unequally bilobate, as in the shark. Fishes with the latter form of tail are termed by M. Agassiz Heterocercal, the others are called Homocercal. See Fig. 2374, where *a* represents the Tail of the Eel: *b*, the Salmon; *c*, the Wrasse; *d*, the Shark.

The peculiarity of the Heterocercal fishes is that the vertebral column runs along the upper caudal lobe: in the other forms of tail it is symmetrically placed with respect to the posterior finny expansion. M. Agassiz has found this peculiarity of the tail, which is least common among living fishes, and confined to particular groups, to belong to every species of fishes, of whatever group, and however differing in other respects, which occur in strata older than the oolitic system, while in and above that system Homocercal forms appear. It is therefore a characteristic of geological time; and is one among several marks of the sauroid character of the fishes which lived in early geological periods.

Fig. 2375 represents—A, the Upper Jaw of a Trout; *e*, the Intermaxillary Bone; *f*, the Maxillary Bone: B, the front view of the Mouth of the Trout, open; *l*, the Vomer, one of the palate bones furnished with teeth; *m*, *m*, the Palatal Bones, also armed in the same manner; *n*, the Tongue, with recurved teeth.

Fig. 2376 is a fanciful picture of the depths of the sea, tenanted by fishes swimming through the silent tranquil waters, undisturbed by the storms that agitate the surface; Fig. 2377 a Group of Fishes.

In all fishes, the skeleton is less firm, less consolidated than in quadrupeds and birds; yet in some are the bones more thoroughly ossified than in others, hence has Cuvier divided the present class into two primary series, namely into Osseous fishes (Ossei), and Cartilaginous (Cartilaginei or Chondropterygii). In the former, the osseous matter is deposited in fibres. The sutures of the cranium are distinct, and maxillary and intermaxillary bones are either one or both present. In the Cartilaginous fishes, the skeleton continues in a state of cartilage; the sutures of the cranium are indistinct, maxillary and intermaxillary bones are either wanting or rudimentary, their place being supplied by the palatal.

The class is divided by Cuvier as follows:—

Series I. Ossei

Section 1. Pectinibranchii

Order 1. Acanthopterygii

Family Percidæ	Family Theutyes
Loricati	Pharyngiens labyrinthiformes
Sciænidæ	Mugilidæ
Sparidæ	Gobiadæ
Mænidæ	Lophiadæ
Squamipinnati	Labridæ
Scombridæ	Centriscidæ
Tænioidæ	

Order 2. Malacopterygii

1. Abdominales	2. Subbrachiales
Family Cyprinidæ	Family Gadidæ
Esocidæ	Pleuronectidæ
Siluridæ	Discoboli
Salmonidæ	Echeneididæ
Clupeidæ	

Order 3. Apodes

Fam.—Murænidæ

Section 2. Plectognathi

Fam.—Gymnodontidæ; Sclerodermi

Section 3. Lophobranchii

Fam.—Syngnathidæ

Series II. Cartilaginei or Chondropterygii

Order 1. Eleutheropomi

Fam.—Sturionidæ; Chimæridæ

Order 2. Plagiostomi

Fam.—Squalidæ; Raiidæ

Order 3. Cyclostomi

Fam.—Pteromyzidæ

In the Ossei, or bony fishes, there are three sections. Those of the first, the Pectinibranchii, possess the following characters:—Branchiæ, in continuous pectinated ridges, furnished with an opercular and branchiostegous membrane; jaws complete and free. Section 2, Plectognathi;—Branchiæ with the pectinations continuous; opercule and rays concealed beneath the skin; external aperture a simple cleft; jaws incomplete; maxillary firmly attached to the side of the intermaxillary, which alone forms the jaw; palatine arch united to the cranium by suture, and immovable. To this section belong the globe-fishes, file-fishes, &c. Section 3, Lophobranchii:—Branchiæ in small tufts; opercule large, confined on all sides by a membrane, with only a small hole for the external aperture; branchiostegous rays rudimentary; jaws complete and free. To this section belong the pipe-fishes, hippocampus, &c.

The two latter sections contain but a limited number of species: the Pectinibranchii, on the contrary, contain all the ordinary and typical fishes, and, as is seen in the foregoing list, is subdivided into three orders. The fishes of the first of these orders, the Acanthopterygii, are distinguished by their having the anterior part of the dorsal, anal, and ventral fins furnished with simple spinous rays. The perches, mullets, gurnards, mackerels, &c., therefore belong to this order. In the second order, the Malacopterygii, all the fin rays are flexible, with the exception sometimes of the first ray of the dorsal and pectoral fins. The three principal divisions of the Malacopterygii are founded either upon the position of certain fins, or their absence. In the first division, the Abdominales, the ventral fins are situated far behind the pectorals; as in the carp, tench, bream, dace, roach, pike, salmon, &c. In the second group, the Subbrachiales, the ventral fins are situated immediately beneath the pectorals (or even a little before them); as we find them in the cod-fish, haddock, and whiting. The flat fishes also belong to this group—such as the plaice, flounder, turbot, sole, &c. To the third and last of these greater divisions of the Malacopterygii belong the eels, which have received the name Apodes, from their possessing no ventral fins.

In illustration of the three orders into which the Cartilaginei are divided, the Sturgeon will serve as an example of the first, or the Eleutheropomi. The Plagiostomi contain the Sharks and Rays; and the Lampreys and Myxines chiefly constitute the Cyclostomi.

ORDER ACANTHOPTERYGII.

Family PERCIDÆ (PERCHES).

2378.—THE PERCH

(*Perca fluviatilis*). In the genus Perca there are two dorsal fins, distinct from each other; the rays of the first fin are spinous, of the second flexible. The tongue is smooth; there are teeth in both jaws on the vomer and palate bones, præoperculum notched below, and serrated on the posterior edge; operculum osseous, ending in a point directed backwards. Branchiostegous rays seven; scales hard.

The perch, which was well known to the ancients, is one of our most common freshwater fishes, abounding in rivers, lakes, and ponds; especially such as are clear, where it is fond of lurking in shoals under the banks, or of swimming near the surface. It is spread throughout the whole of temperate Europe, and exists in Lapland. Its food consists of insects, worms, and fishes, which it seizes with great voracity. Walton, indeed, describes the perch as "a very bold-biting fish."—whence it is an easy prey to the angler, who often captures on his hook considerable numbers in rapid succession, one after another eagerly taking the bait.

Mr. Turton, an experienced angler of Sheffield, mentions an instance in which sixty perch were taken by the red-worm, during a few hours, one evening, out of a reservoir near Chapel-en-le-Frith in Derbyshire. This fish is easily tamed, and may be made so familiar as to take food from the hand. Mr. Jesse informs us, that in a piscatorium or preserve at Bushy Park, the perches proved the boldest and most familiar of any fish, and that he soon found no difficulty in getting them to take a worm out of his hand.

The perch, like the carp, is very tenacious of life, and if packed in wet moss, and occasionally refreshed with water, it will live for many hours; indeed, in some parts of the continent, they are taken from the pond in the morning, carried thus to the market, and, if not sold, restored to their liquid home in the evening. Those who handle the perch alive, should be careful of the sharp spinous rays of the first dorsal fin, by which we have known the fingers lacerated. This species differs much in size, apparently according to the quality of the water and nutriment. They in general average from half a pound to a pound; a perch of three pounds would be considered as very large: Mr. Jesse states, that "great numbers of perch are bred in the Hampton Court and Bushy Park ponds, all of which are well supplied with running water, and with plenty of food. Yet they seldom arrive at a large size. In a neighbouring pond, which is only fed with drainage water, I have caught very large perch. The perch in the Regent's Park are very numerous. Those I have taken, however, are almost invariably of one size, from half to three quarters of a pound. Why they should have arrived at this size, and not go on increasing in magnitude, is a circumstance which it is not easy to account for. I have, however, remarked it to be the case in other ponds."

Mr. Yarrell gives many instances of enormous perch having been taken in different places, varying from five to nine pounds in weight. The flesh of the perch is firm, white, and of good flavour. The spawning time is at the end of April or beginning of May. The roe of a small perch, only half a pound in weight, has been found to contain 280,000 eggs. The form and colours of the perch are too well known to need description. We may observe, however, that there are two external openings to each nostril, surrounded by the orifices of numerous mucous ducts, from which oozes a secretion for defending the skin from the action of the water. On this Mr. Yarrell remarks, "The distribution of the numerous orifices over the head is one of those beautiful and advantageous provisions of nature, which are so often to be observed and admired. Whether the fish inhabits the stream or the lake, the current of water in one instance, or progression through it in the other, carries this defensive secretion backwards, and spreads it over the whole surface of the body. In fishes with small scales this defensive secretion is more abundant in proportion; and in those species which have the body elongated, as the eels, the mucous orifices may be observed along the whole length of the lateral line.

The following is the formula of the fin rays:—

D. 15, 1+13. P. 14. V. 1+5. A. 2+8. C. 17.

The meaning is this: D., the dorsal, has in the first fin 15 rays all spinous; in the second fin, 1 spinous, and 13 that are soft. P., the pectoral fin, has 14 soft rays. V., the ventral fin, with 1 spinous ray, and 5 that are soft. A., the anal fin, with 2 spinous, and 8 that are soft. C., the caudal fin, with 17 rays. The formula, abbreviated as above, is very convenient, and easily understood.

2379, 2380.—THE BASSE

(*Labrax Lupus*). Perca labrax, Linn. In its generic characters, Labrax closely approximates to Perca; the cheeks, præoperculum and operculum are covered with scales; the præoperculum is notched below, and serrated posteriorly; the operculum ends in two points directed backwards; the tongue is covered with small teeth.

This Basse may be regarded as a marine perch, and was known to the Greeks by the name of Labrax (Λαβραξ), from Labros (Λαβρος), voracious; the Romans from its disposition called it Lupus, or wolf. It was caught abundantly in the Mediterranean, and highly esteemed for the table. It is found along the whole line of our southern coast, and in St. George's and the Bristol Channel. It also frequents the eastern shore of the Irish coast.

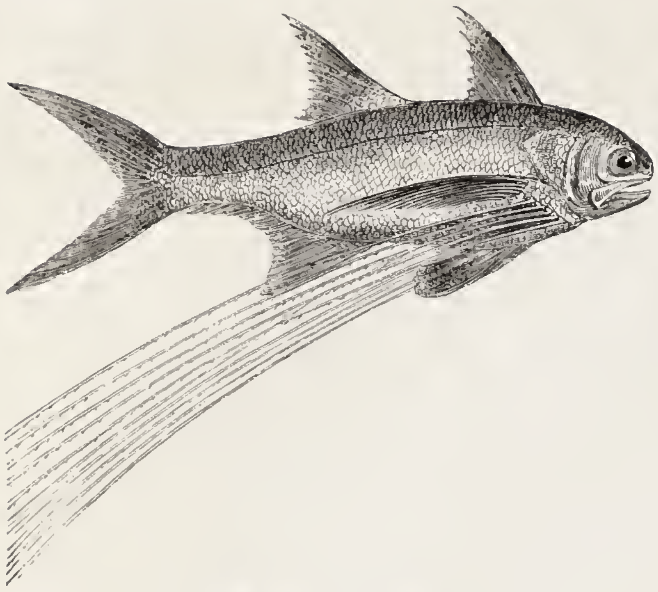
The Basse associates in shoals, which at the spawning time frequent the mouths of rivers, or even advance up the stream to a considerable distance; indeed, as has been proved by Mr. Arnold, this fish will not only live, but thrive in fresh water altogether, the flesh acquiring a superior flavour. This fish generally measures from twelve to eighteen inches in length, but is often caught much larger, and Willughby states that individuals have been captured of the weight of fifteen pounds.

Its food consists of small fishes and various crustaceans; and as it takes the bait freely it may be captured with the rod and line. The net is most generally employed. On the Kentish coast the Basse is termed the sea-dace.

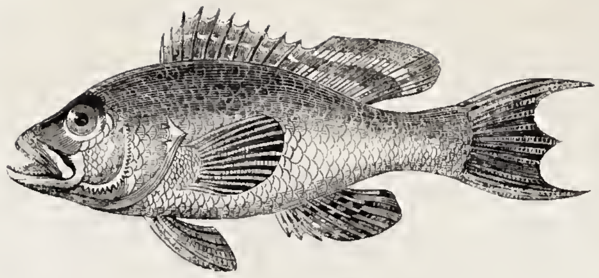
In its form this fish is more elongated than the perch. The nostrils have two orifices; the mucous pores are numerous. The general colour of the back is dusky blue, passing on the under-parts into silvery white; the fins are brown; the irides silvery; the scales are moderate and adhere firmly.

2381.—THE BLACK BASSE

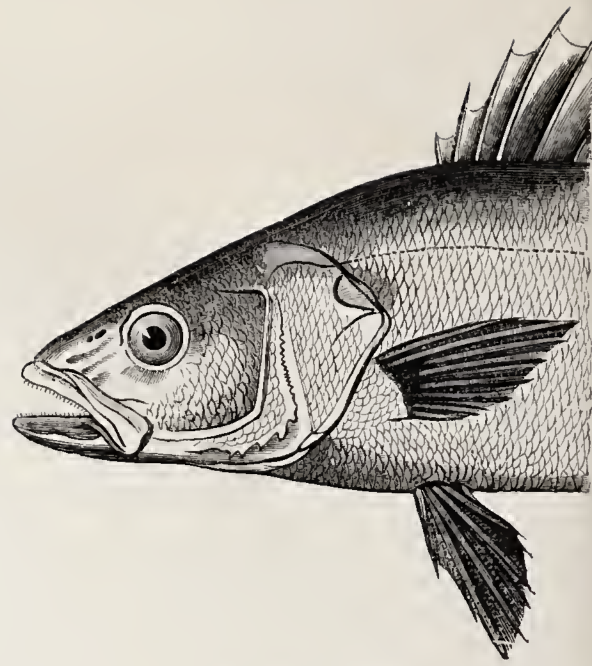
(*Centropistis nigricans*). The genus Centropistis belongs to the division of the Percidæ with bran-



2382.—Attedi's Polynemus.

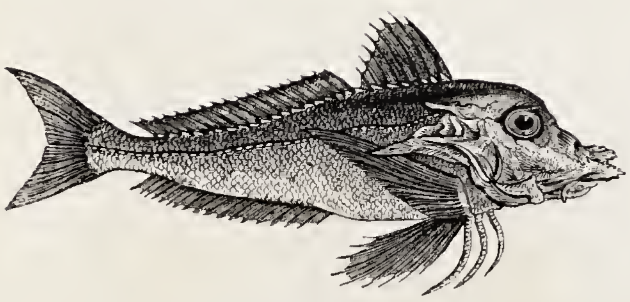


2381.—Black Basse.

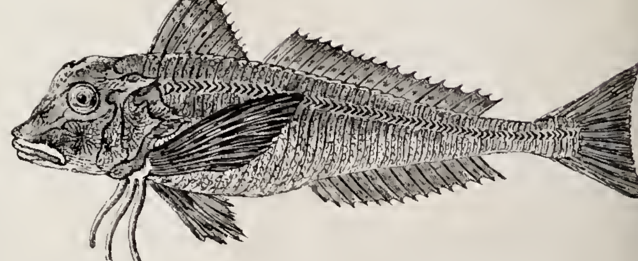


2379.—Head of Basse.

2378.—Perch.

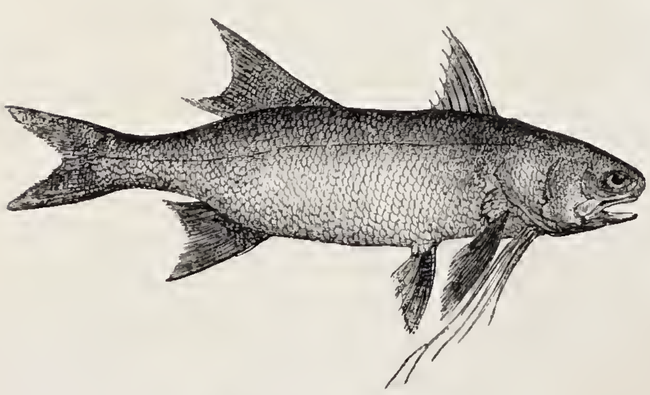


2385.—Piper.

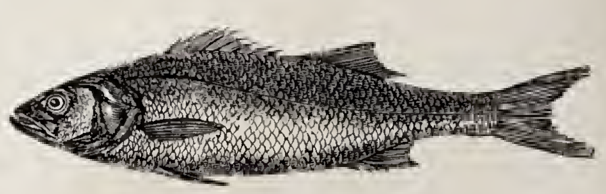


2384.—Streaked Gurnard.

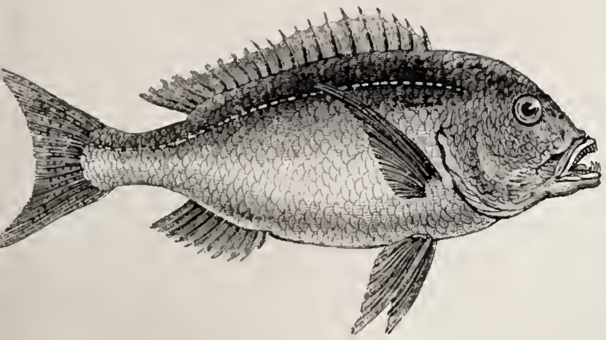
2386.—Indian Flying Gurnard.

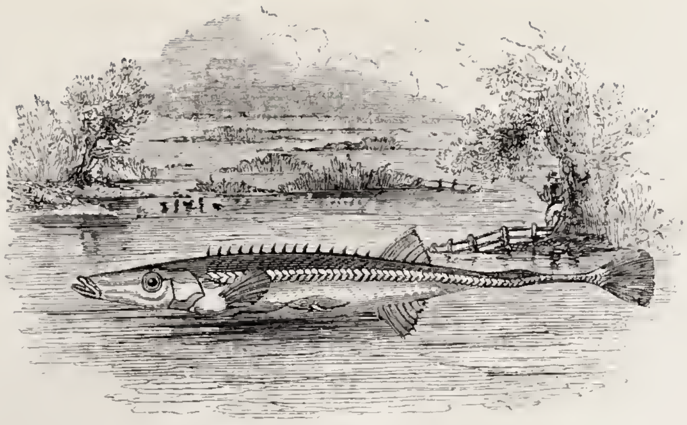


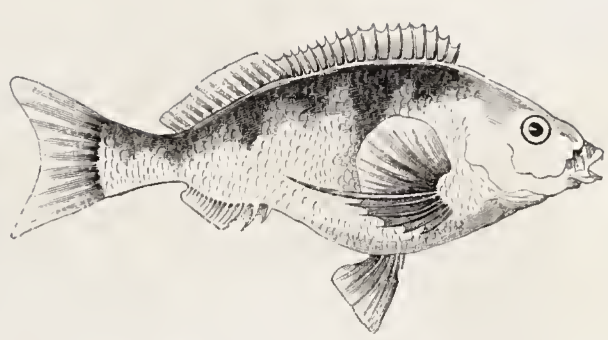
2383.—Four rayed Polynemus.



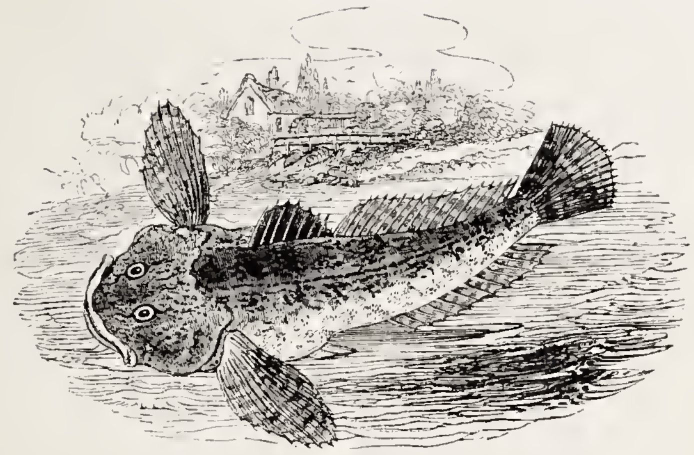
2380.—Basse.

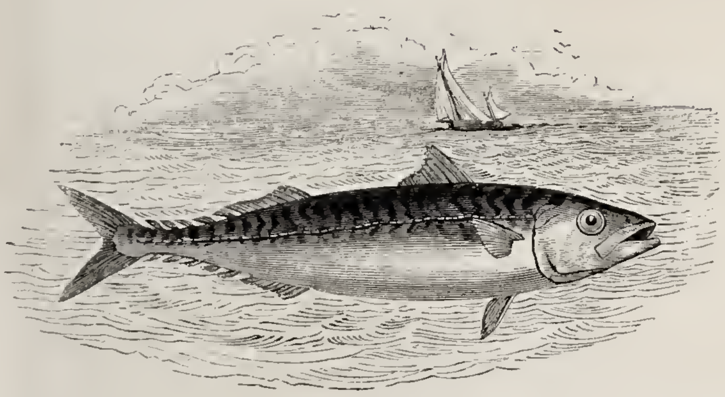

2391.—Braize.

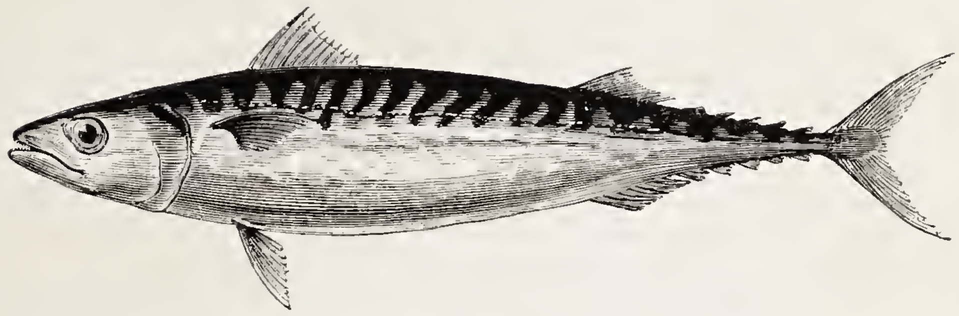

2389.—Fifteen spined Stickleback.

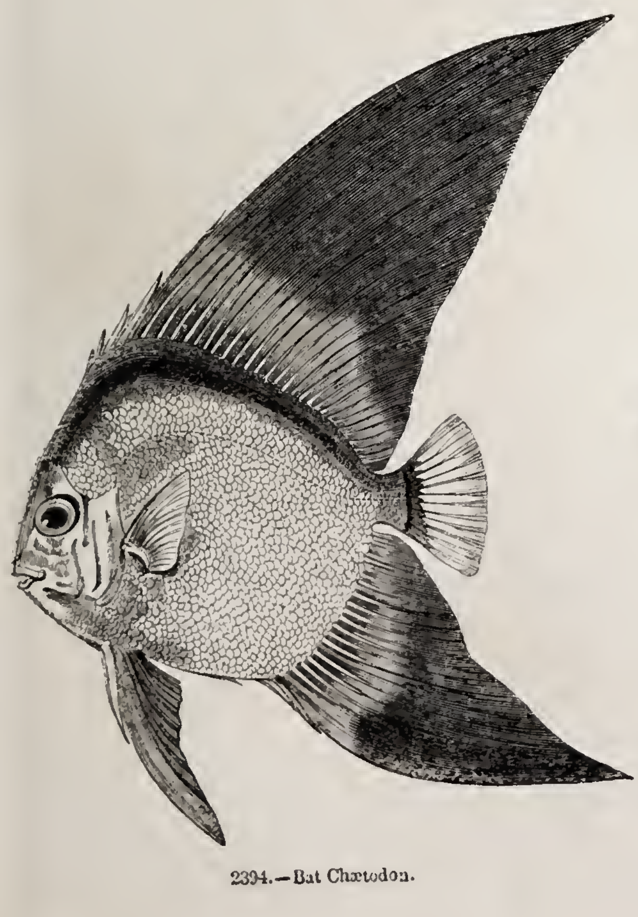

2390.—Carmichael's Cheilodactyle.


2388.—Japanese Pogge.


2387.—Miller's Thumb.


2395.—Mackerel.


2396.—Mackerel.


2394.—Bat Chætodon.


2393.—Surgical Chætodon.


2392.—Wandering Chætodon.

chiostegous rays, and a single dorsal fin, the anterior portion of which is supported by spinous rays; the teeth are fine, strong, recurved, and closely set; the præoperculum is serrated, and the operculum with a spine directed backwards.

The black basse or black perch is abundant in the rivers of the United States of America, where it attains to a large size, and is in much request for the table. When young, the caudal fin is remarkable for a central point between the upper and under points, which are much produced. In old individuals, this additional apex becomes almost obsolete. In the young stage, this species is the Perca trifurca of Linnæus, the Lutgan trilobé of Lacépède, the general colour of this species above is intense olive green, passing into pinkish on the under-parts; the dorsal fin is bluish with paler streaks; the other fins are deep blue; the caudal fin is spotted.

2382.—Artedi's Polynemus

(*Polynemus Artedii*, Benn.). The genus Polynemus belongs to that section of the Percidæ, characterized by Cuvier as having the ventral fins placed more backward than the pectoral fins, while under the latter are long filaments, free rays of those fins, not united by membrane to the rest. The teeth are minute and so densely crowded, as to resemble the pile of velvet, or rather the teeth of a carding machine. They are found on both jaws as well as on the vomer and palate bones; the eyes are large, the dorsal fins widely separated; the caudal fin is ample, and more or less forked. The præoperculum is serrated, and the operculum many-spined.

Artedi's Polynemus was confounded by Cuvier with an allied species from the Bay of Bengal, and the estuaries of the Ganges, known as the Tupsee or Mango fish (P. longifilis, Cuv.), and was first discriminated by the late E. T. Bennett, Esq., who described it in the 'Proceeds. Zool. Soc.,' Nov. 1831, p. 146. It is a native of the Atlantic coast of Northern Africa. Like the Mango fish, it is remarkable for the length of five free pectoral rays, on each side extending beyond the body.

2383.—The Four-rayed Polynemus

(*Polynemus quadrifilis*). This species is also from the African coast, but the four free rays of the pectoral fins are comparatively short.

The following is an interesting extract of some observations, relative to several of the Indian species of this genus, in the 'Proceeds. Zool. Soc.,' July, 1839, by Dr. Cantor:—

"In the December number, 1838, of Parbury's 'Oriental Herald,' appears a letter: 'On the Suleah Fish of Bengal, and the Isinglass it affords:' the description of this fish I shall quote in the words of the anonymous writer. 'The Suleah Fish,' he observes, 'when at its full size, runs about four feet in length, and is squaliform, resembling the shark species in appearance, but exhibiting a more delicate structure than the latter. The meat of this fish is exceedingly coarse, and is converted by the natives, when salted and spiced, into "burtah," a piquant relish, well known at the breakfast tables of Bengal. The bladder of the Suleah may be considered the most valuable part of it, which, when exposed to the sun and suffered to dry, becomes purely pellucid, and so hard that it will repel the edge of a sharp knife when applied to it. These bladders vary from half a pound to three quarters of a pound avoirdupois in weight, when perfectly dry. . . . The Suleah Fish abounds in Channel Creek, off Saugor, and in the ostia or mouths of all the rivers which intersect the Sunderbuns, and are exceedingly plentiful at certain seasons.'

"Conceiving the great importance of the discovery of isinglass being a product of India, I was naturally anxious to examine the source, arising from a branch of natural history to which in particular I have devoted my attention; but from the general nature of the description, I was obliged to defer my desire of identifying the fish till some future opportunity should enable me to do so. Quite unexpectedly, however, a few days ago, the last overland despatch brought me a letter from my valued friend M. McClelland, a corresponding member of this Society, an extract of which, bearing upon the point in question, I lose no time in laying before the Society:—'. . . . I have now to mention what is of far greater importance in another point of view, namely, that the Suleah Fish described in a recent number of Parbury's 'Oriental Herald' is the Polynemus Sele of Hamilton. I have examined that species, and found an individual of two pounds weight to yield sixty-five grains of pure isinglass, an article which here sells at sixteen rupees (1*l.* 12*s.*) per lb. Refer to your dissections of Polynemi; mark those with large air-vessels to be isinglass, requiring no other preparation than merely removing the vascular membrane that covers them, washing with lime-water, and drying in the sun. You know the size these fishes attain, and the number in which they abound in the Sunderbuns; you also know the method of taking them, and can therefore state to what extent isinglass may be obtained in India. I have sent a paper on the subject to the Journal of the Asiatic Society, which I will send you by the next overland despatch.'

Family LORICATI (HARD-CHEEKED ACANTHOPTERYGIANS, as GURNARDS, &c.)

The Loricati are described by Cuvier as fishes of singular aspect, having the head variously spined and cuirassed, but in many respects approaching the Percidæ.

2384. The Streaked Gurnard

(*Trigla lineata*). The Gurnards, of which we have several British species, are known by the squared form of the head, covered with bony plates, the gill-cover and shoulder-plate ending in a spine directed backwards: the body is tapering; there are two dorsal fins; the rays of the first are spinous. Teeth in both jaws and on the vomer, small, pointed, and numerous. Branchiostegous rays seven; gill-opening large; three detached rays at the base of each pectoral fin. The Sapphirine Gurnard, Trigla Hirundo, is common in the fishmongers' shops of London, with its ample pectoral fins spread out, giving it a strange appearance. When taken out of the sea these fishes emit a grunting or croaking noise at intervals, for a considerable time. They are very tenacious of life, and mostly swim near the bottom in deep water. The swimming bladder is large, in some species simple, in others divided into two or three lobes, with strong lateral compressor muscles. Their food consists principally of crustacea.

The streaked gurnard is a rare species near our shores, but is common in the Mediterranean, about the Canary Islands, and Teneriffe. It seldom exceeds twelve or fourteen inches in length. The head of this species is short, the profile abruptly oblique; the spines about the head are moderate; and the body exhibits transverse lines extending from the ridge of the back down each side, every line consisting of two rows of square ciliated scales. The general colour of the body and fins is a rich red; the latter are often marbled and edged with a darker tint; the pectoral fins are marbled transversely with blue. Under parts white.

2385.—The Piper

(*Trigla Lyra*). This species, like the preceding, is rare about our shores, but is common in the Mediterranean. It measures about two feet in length, and weighs between three and four pounds. Its name of Piper is supposed to be derived from the noise it utters when captured, and which is doubtless occasioned by the forcible pressure of the muscles on the swimming bladder. Its flesh is considered excellent. The head of the piper is large; the nasal projections considerable; the opercular spines bold and sharp; the serrations of the ridge of the back very decided. The general colour is a brilliant red, passing on the under parts into silvery white.

2386.—The Indian Flying Gurnard

(*Dactylopterus orientalis*). Flying-fishes, as they are termed, occur in two very distinct orders: there are the Flying Gurnards of the Acanthopterygious order; and the Flying-Fishes of the Malacopterygious order, constituting the genus Exocetus; and between these in their narratives voyagers seldom discriminate. We read their accounts, but are left in complete uncertainty not only as to the species, but the general characters of the fish whose aërial evolutions they are detailing.

The flying gurnards (Dactylopterus) may be at once distinguished from the ordinary gurnards by the enormous development of the pectoral fins or rather of the subpectoral rays, which are free in the latter, but are in these species enormously lengthened, very numerous, and connected together by a fine membrane. The muzzle is very short and abrupt; the jaws are paved with rounded teeth; the præoperculum terminates in a long sharp spine, constituting a formidable weapon; the eyes are large; the scales are all keeled.

Two species are known,—the Common Flying Gurnard (D. volitans), abundant in the Mediterranean; brown above, rose-coloured below, with the fins varied with blue on a black ground. It varies from a foot to fifteen inches in length.

The Indian Flying Gurnard is a native of the Indian seas, and attains the length of twenty inches. Shoals of these fishes pursued by the dolphin, or bonito, having attained the necessary impetus in their course, suddenly rise into the air, where they skim onwards sustained for a short time by their ample quivering pectoral fins, presenting a beautiful spectacle. After a brief career they descend again into the waters, and again re-appear at a distance, and thus often continue till beyond reach of sight, all the time chased by their persevering enemies. When the flying-fish rises, it is exposed to fresh assailants. The frigate-bird and the albatross are sailing on wide-spread wings over the sea, watching the movements of its finny tenants, and ready to sweep down with unerring aim upon the hapless fish that approaches the surface, or rises above it. Though these and other fishes are said to fly, their flight is a mere skim through the air, effected by the parachute of their pectoral fins; to rise above the surface and dart onwards they require a powerful impulse, and this is given by their rapid course previously, and by a sudden and vigorous action of the tail at the moment of rising. It is interesting to find animals thus furnished with parachutes, among the mammalia, among the lizards, and among fishes.

2387.—The River Bullhead, or Miller's Thumb

(*Cottus Gobio*). In the genus Cottus the head is large and depressed; there are sharp small teeth on the vomer, and in the jaws. The gill-covers are armed with spines; branchiostegous rays six. Body slender, naked, without scales. Two dorsal fins; ventral fins small.

This little strange-looking fish is common in all the clear fresh water streams of our islands, and the continent of Europe. We have seen it in abundance in small rivulets running over a gravelly or rocky bed, under the stones of which it generally lurks, or between the crevices, its dusky colour aiding its concealment. When disturbed it darts away very rapidly. Its food consists of the larvæ of aquatic insects, and small worms, at which it freely bites, but is seldom captured, except by children. It spawns in summer. This well-known fish rarely exceeds four or five inches in length. We need not enter into a detailed description. Its eyes, from the depression of the head, which is broad as a miller's thumb, look upwards.

2388.—The Japanese Pogge, or Armed Bullhead

(*Aspidophorus accipenserinus*); Agonus accipenserinus, Bloch.

In the genus Aspidophorus the body is octagonal, covered with scaly plates; the head is thick with points and depressions above, flattened below; teeth in the jaws only; snout with recurved spines; branchiostegous rays six; body long and tapering; two dorsal fins distinct.

One species, the Common Pogge, is found in our seas. It is of small size, about six inches in length, occurring in the Baltic, along the coast of Norway, and in the Northern Sea to Greenland and Iceland. It is also tolerably common along our southern coast, and still more so on the eastern, and is frequently taken at the mouth of the Thames. The body is divided longitudinally by eight scaly ridges, and defended by eight rows of strong scaly plates: the under jaw is furnished with several minute cirrhi; and the nose has three recurved spines. The Japanese Pogge is clearly allied to the British species, and is found in the North Pacific Ocean, along the coast of Japan, and northwards as far as Behring's Straits. Its food consists of small crustaceans.

2389.—The Fifteen-spined Stickleback

(*Gasterosteus spinachia*, Linn). The Sticklebacks are little fishes found respectively both in fresh and salt water, having the body without scales, but more or less plated on the sides; there is only one dorsal fin with the free sharp spines, varying in number, before it; the ventral fin is in the form of a strong spine without other rays; the abdomen is protected by an osseous cuirass, formed by a union of the pelvic and humeral bones. Branchiostegous rays three. Of this genus Mr. Yarrell describes the following British species. The Rough-tailed stickleback (G. trachurus), common in both salt and fresh water; the Half-armed stickleback (G. semiarmatus), found with the preceding; the Smooth-tailed stickleback (G. leiurus), also common; the Short-spined stickleback (G. brachycentrus) found in the streams, ponds, and sea of the north of Ireland; the Four-spined stickleback (G. spinulosus), found near Edinburgh; the Ten-spined (G. pungitius), found both in the sea and rivers; and the Fifteen-spined stickleback (G. spinachia). The latter is of more elongated form than the others, and is common around our coast, and in the Baltic, seldom, however, ascending rivers. It is fierce and voracious, devouring the fry of other fishes, crustaceans, &c. Like all the sticklebacks it is very pugnacious, attacking other fishes with determined ferocity. Mr. Yarrell gives the following account of its habits as supplied by Mr. Couch. "It keeps near rocks and stones covered with seaweeds, among which it takes refuge upon any alarm. Though less active than its brethren of the fresh water, it is scarcely less rapacious. On one occasion I noticed a specimen six inches in length engaged in taking its prey from a clump of

oreweed, in doing which it assumed every posture from the horizontal and perpendicular, with its head downward or upward, thrusting its snout into the crevices of the stems, and seizing its prey with a spring. Having taken this fish with a net, and transferred it to a vessel of water in company with an eel three inches in length, it was not long before the latter was attacked, and devoured head foremost; not indeed altogether, for the eel was too large a morsel to be managed, so that the tail remained hanging out of the mouth; and it was obliged at last to disgorge the eel partly digested. It also seized from the surface a moth that fell on the water, but threw up the wings. The effect of the passions on the colour of the skin of this species is remarkable; and the specimen now spoken of, under the influence of terror, from a dark olive with golden sides, changed to pale for eighteen hours, when it as suddenly regained its former tints. It spawns in spring, and the young, not half an inch in length, are seen in considerable numbers at the margin of the sea in summer."

Family SCIÆNIDÆ (THE MAIGRES).

2390.—CARMICHAEL'S CHEILODACTYLE

(*Cheilodactylus monodactylus*). The genus Cheilodactylus, one of the genera of the family Sciænidæ, has the body oblong, the mouth small; the spiny rays of the dorsal fin, and also of the pectoral, are simple, and prolonged beyond the membrane.

Carmichael's Cheilodactyle is very common on the coast of the island of Tristan d'Acunha, where it feeds upon a species of seaweed, fucus pyriferus. It is about eighteen inches in length; the teeth are small and crowded; the pectoral fin is large, with fifteen rays, the six lower of which are simple, and project beyond the membrane, the sixth from the lowermost being greatly elongated. The general colour is olive or bronze, with six dark stripes on the back; pectoral fins amber; the rest blackish.

Family SPARIDÆ (SEA BREAMS).

2391.—THE BRAIZE, OR BECKER

(*Pagrus vulgaris*); Sparus pagrus, Linn.

In the genus Pagrus there are four or six conical teeth in front, with a number of smaller conical teeth behind them, and two rows of rounded molar teeth on each side of both jaws. The body is deep and compressed; dorsal fin single; cheeks and operculum covered with scales; branchiostegous rays six.

This fish, with the Gilt-head, the Maigre, the Umbrina, and other allied species, is found in the Mediterranean, along the coasts of France, Spain, and Italy. It appears on the Cornish coast in moderately deep water in summer and autumn, migrating on the approach of winter.

The general colour of the Braize is silvery tinged with red; the fins are tinged with rose-colour; the pectorals red. Formula of fin rays as follows;—D. 12+10, P. 15, V. 1+5, A. 3+8, C. 17.

Family SQUAMIPINNATI (CHÆTODONS, &c., with the spiny parts of the dorsal fin encrusted with scales).

2392.—THE WANDERING CHÆTODON

(*Chætodon vagabundus*). The Chætodons are beautifully coloured fishes of singular figure, abounding in the seas of the hotter climates. Their most common tints are black and yellow, but metallic blues and greens are not unfrequent. Sometimes the colours are disposed in spots, mostly, however, in stripes or bands. The body is deep, often almost circular, and compressed; the tail short; the mouth small, with several closely set rows of long slender bristle-like teeth. The air-bladder is large, and the alimentary canal long and ample. They generally haunt rocky shores; their flesh is accounted excellent.

In the restricted genus Chætodon the scales extend on to the dorsal and anal fins, so as to cover their base. The rays of the dorsal fin form a tolerably uniform curve, and the snout is produced.

The Wandering Chætodon is a native of the coasts of Ceylon; the ground colour of the body is yellow, with numerous oblique brownish purple lines; a broad black vertical band extends through the eye. The dorsal fin is blackish, and has thirteen spinous rays; the tail is yellow with black bands, and the adjacent fin is black with a bent yellow stripe, and a yellow margin. Length ten or twelve inches.

One species, the Chætodon rostratus, with a long snout, is remarkable for the manner in which it takes insects, by shooting drops of water at them as they rest on the rocks or plants about the shore, so as to bring them down, when it seizes and devours them. The Chinese in Java, it is said, are in the habit of amusing themselves with its feats.

Another fish of the same family, the Archer (Toxotes jaculator), takes insects in the same manner, and will throw the drops of water to the distance of three or four feet, rarely missing its aim. It is also a native of the sea round Java.

There is a group of fishes commonly termed "doctors," in consequence of being provided with two very sharp and movable spines, like lancets, one on each side of the tail, and with which they inflict a very severe wound on the hands of those who touch them incautiously; hence they are well known to the sailors visiting the tropical seas. The mouth is small, the muzzle rather prominent; the teeth are trenchant and denticulated, like a very fine comb. They are among the comparatively limited number of fishes which subsist on vegetable aliment, algi, fuci, and other marine plants constituting their food. Peaceful and inoffensive, they wander about the submerged rocks clothed with luxuriant vegetation, and never voluntarily make an attack, but content themselves with repelling the assaults of their enemies, using their weapons with great energy. The species are found about the shores both of the East and West Indies, and their flesh is said to have a peculiar flavour.

2393.—THE SURGICAL CHÆTODON

(*Acanthurus chirurgius*). This species, which was first described by Bloch, is a native of the Indian seas. It was regarded by him as a chætodon, but the genus Acanthurus of Lacépède, of which it forms one of the examples, is separated from the chætodons by Cuvier into a distinct family, "Les Theutyes," all the groups of which are herbivorous. To this family it of right belongs, but we here allude to it, as it is the chætodon chirurgius of Bloch.

2394.—THE BAT CHÆTODON

(*Platax vespertilio*). The genus Platax is remarkable for the extremely compressed form of the body, the wing-like elevation of the dorsal fin, and the length of the ventral fins, and of that adjacent to the tail. The jaws are furnished with a row of trenchant teeth divided into three points, and behind them is a number of thickly set fine teeth (dents en brosse). The recent species are restricted to the Indian seas. One has been found in a fossil state at Mount Bolca.

The Platax vespertilio is a native of the coast of Ceylon, inhabiting deep water, often among rocks; it attains to a large size. Its general colour is yellowish, mottled with dark brown; a blackish stripe extends downwards through the eye; the fins are brown.

Family SCOMBRIDÆ (SCOMBERS, MACKEREL, TUNNIES, SWORDFISH, &c.).

This family is composed of a number of fishes with small scales and a smooth body; having the tail and caudal fin very vigorous.

"It is," says Cuvier, "one of the families the most useful to man, from the agreeable flavour and size of the species, while their inexhaustible reproduction leads them back periodically to the same localities, and thus renders them the objects of fisheries on the most extensive plan."

2395, 2396.—THE MACKEREL OR MACKAREL

(*Scomber scombrus*). In the genus Scomber there are two dorsal fins widely separated, and some portions of the posterior dorsal fin and its opposite beneath, form detached, or, as they are called, false fins; the sides of the tail are slightly carinated; there is one row of small conical teeth in each jaw; branchiostegous rays seven.

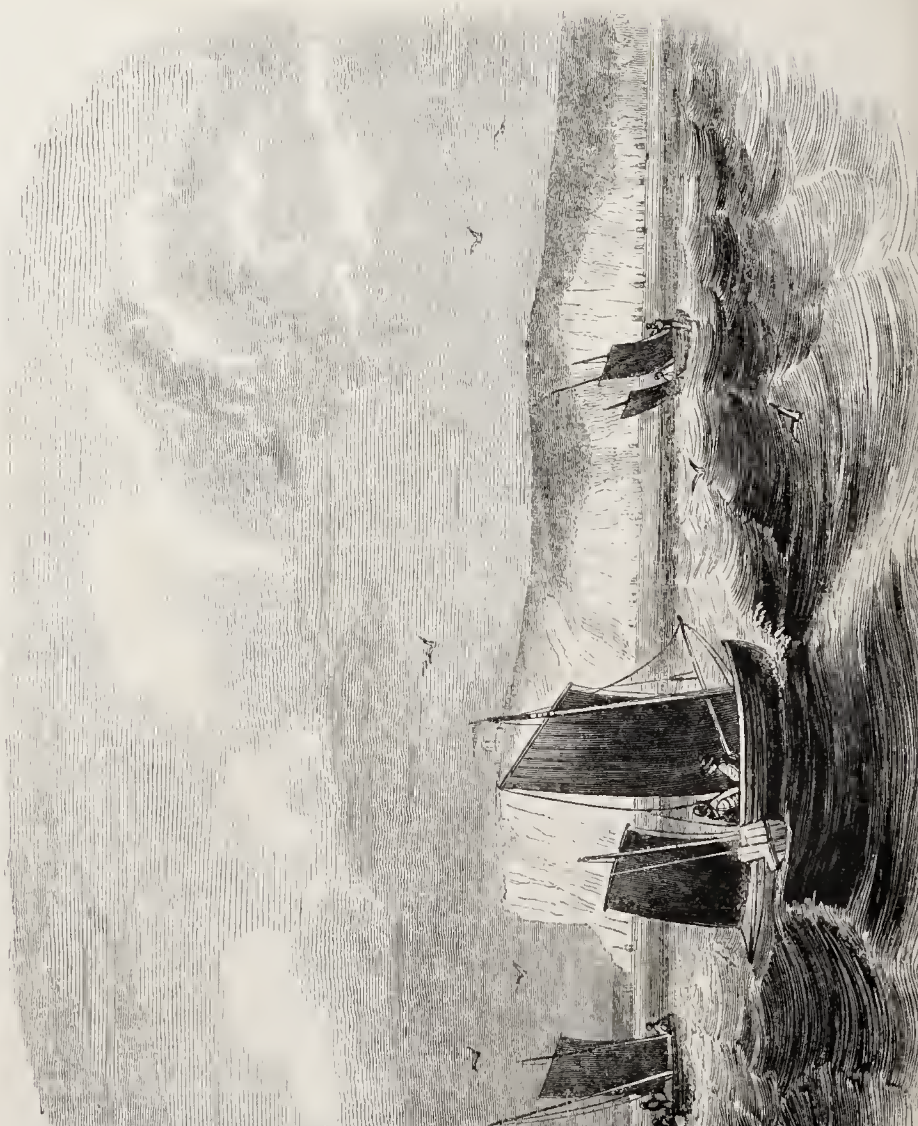
We need not describe this beautiful fish resplendent in green and silver barred with a dusky tint, nor insist upon its excellence as an article of food, prized alike at the table of the wealthy and of the humble.

The mackerel approaches the coast in large shoals, and it was formerly considered that its annual movements were from northern to southern latitudes, and from southern to northern; but this fish is to be met with in our own seas at all seasons of the year, though in the winter they are not found in great numbers; and the situation of those parts of the coast where they make their first appearance disproves the fact of their migrating only in a southern direction when the season has become more genial, as they frequently appear on a southern part of the coast before they have visited its northern limits. On the Cornish coast, which the fish often visit so early as the month of March, the course of the shoals seems to be from west to east. This year the fishing season on the Sussex coast commenced early in February, and some were taken in January, but the number was small, and they were sold in London at from one to two shillings each. When the fishermen commence very early in the year, they have to proceed a considerable distance out to sea, as the fish do not approach the coast until a more advanced period. May and June are the busiest months for mackerel fishing. In the latter month they spawn, the female roe containing above half a million ova. The process of depositing spawn takes place earlier on a sandy and shallow shore than on a rugged coast, the former being also more favourable to vivification. Previous to winter, the young retire to deep water. The mackerel may be considered as frequenting nearly every part of the coasts of the United Kingdom, but it is most abundant on the southern portion of Great Britain, on the coasts of Sussex, Kent, Hampshire, and the western counties, and on those of Suffolk and Norfolk. They do not make their appearance on the Scotch coast until late in the summer. Whatever may be the fact as to their migration to the arctic seas, the following statement, taken from the 'Edinburgh Journal of Science,' shows that they are found in those latitudes under singular circumstances:—"Admiral Pleville-Lepley, who had had his home on the ocean for half a century, assured M. Lacépède, that in Greenland, in the smaller bays surrounded with rock, so common on this coast, where the water is always calm, and the bottom generally soft mud and juice, he had seen, in the beginning of spring, myriads of mackerel, with their heads sunk some inches in the mud, their tails elevated vertically above its level; and that this mass of fish was such, that at a distance it might be taken for a reef of rocks. The admiral supposed that the mackerel had passed the winter torpid under the ice and snow; and added, that for fifteen or twenty days after their arrival, these fishes were affected with a kind of blindness, and that then many were taken with the net; but as they recovered their sight, the nets would not answer, and hooks and lines were used."

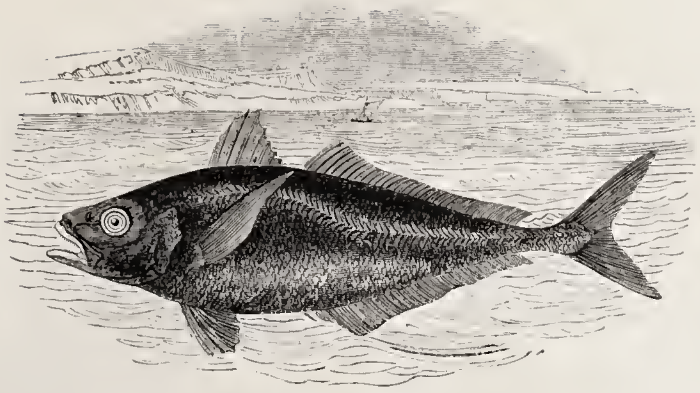
The mackerel fishery is, perhaps, the liveliest, if not the most interesting, of any which are carried on in the British Islands. The flesh of the mackerel being very tender, the greatest dispatch is used in conveying it to market, another incentive to exertion being the high price obtained for those fish which first arrive. The boats are frequently putting off and returning to the shore, the cargoes being conveyed by land carriage to the metropolis; or, from some parts of the coast, by vessels towed by a steam-tug. A light gale, which gently ripples the surface of the water, and is called a mackerel gale, is most favourable to the fisherman, who chiefly follows his employment during the night. There are three modes of fishing,—with drift-nets, with seans, and with the line. By the latter mode a couple of men will take from five hundred to one thousand fish in one day, if the weather be favourable. The French boats frequently go out with six or eight people on board, all of whom fish with the line; and some of them are sufficiently adroit to pay attention to a couple of lines at the same time. The fish bite voraciously, and are taken with great rapidity by a bait cut from its own kind, and made to resemble a living fish. They will seize, and may be taken by, a piece of scarlet cloth or leather. The sean fishing requires two boats, and resembles in some respects the same mode applied to the taking of pilchards, though on a smaller scale. The sean, however, is sometimes hauled on shore. The drift-net fishing is the most common, and by this mode a larger number of fish can be taken than in any other way. The drift-nets are worth from twenty to thirty shillings each. Mr. Yarrell's work contains the following minute account of the drift-net fishing:—"The drift-net is twenty feet deep by one hundred and twenty feet long, well corked at the top, but without lead at the bottom. They are made of small fine twine, which is tanned of a reddish brown colour, to preserve it from the action of the sea-water; and it is thereby rendered much more durable. The size of the mesh about two inches and a half, or rather larger. Twelve, fifteen, and sometimes eighteen of these nets are attached lengthways, by tying along a thick rope, called the drift-rope, and, at the ends of each net, to each other. When arranged for depositing in the sea, a large buoy attached to the end of the drift-rope is thrown overboard, the vessel is put before the wind, and, as she sails along, the rope with the nets thus attached is passed over the stern into the water till the whole of the nets are run out. The net thus deposited hangs suspended in the water perpendicularly twenty feet deep from the drift-rope, and extending from three-quarters of a mile to a mile, or even a mile and a half, depending on the number of nets belonging to the party or company engaged in fishing together. When the whole of the nets are thus handed out, the drift-rope is shifted from the stern to the bow of the vessel, and she rides by it as if at anchor. The benefit gained by the boat's hanging at the end of the drift-rope is, that the net is kept strained in a straight line, which without this pull upon it would not be the case. The nets are shot in the evening, and sometimes hauled once during the night; at others allowed to remain in the water all night. The fish roving in

2399.—Selling Fish by Dutch Auction.

2397.—French boat, angling for Mackerel.



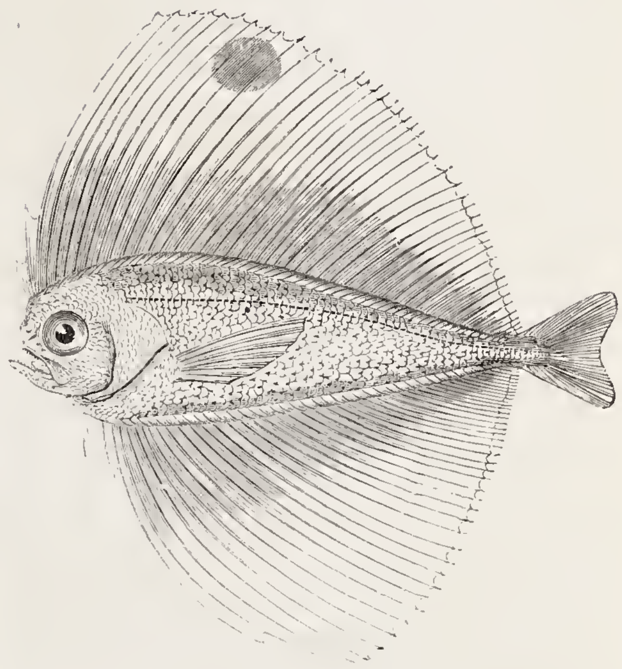
2402.—Starred Coryphæna.



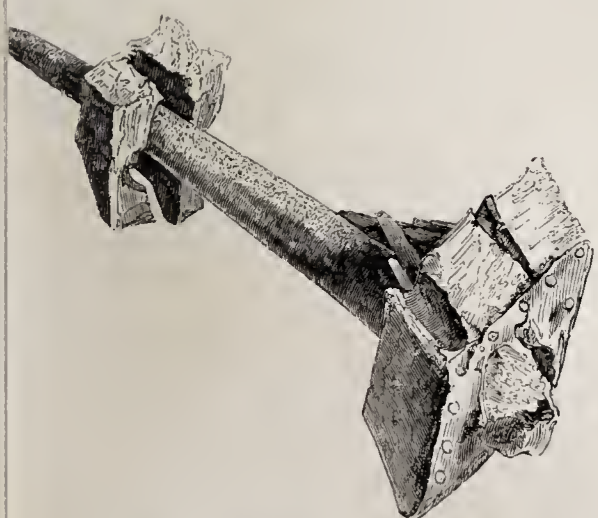
2400.—Horse-Mackerel.

2401.—Dorado.

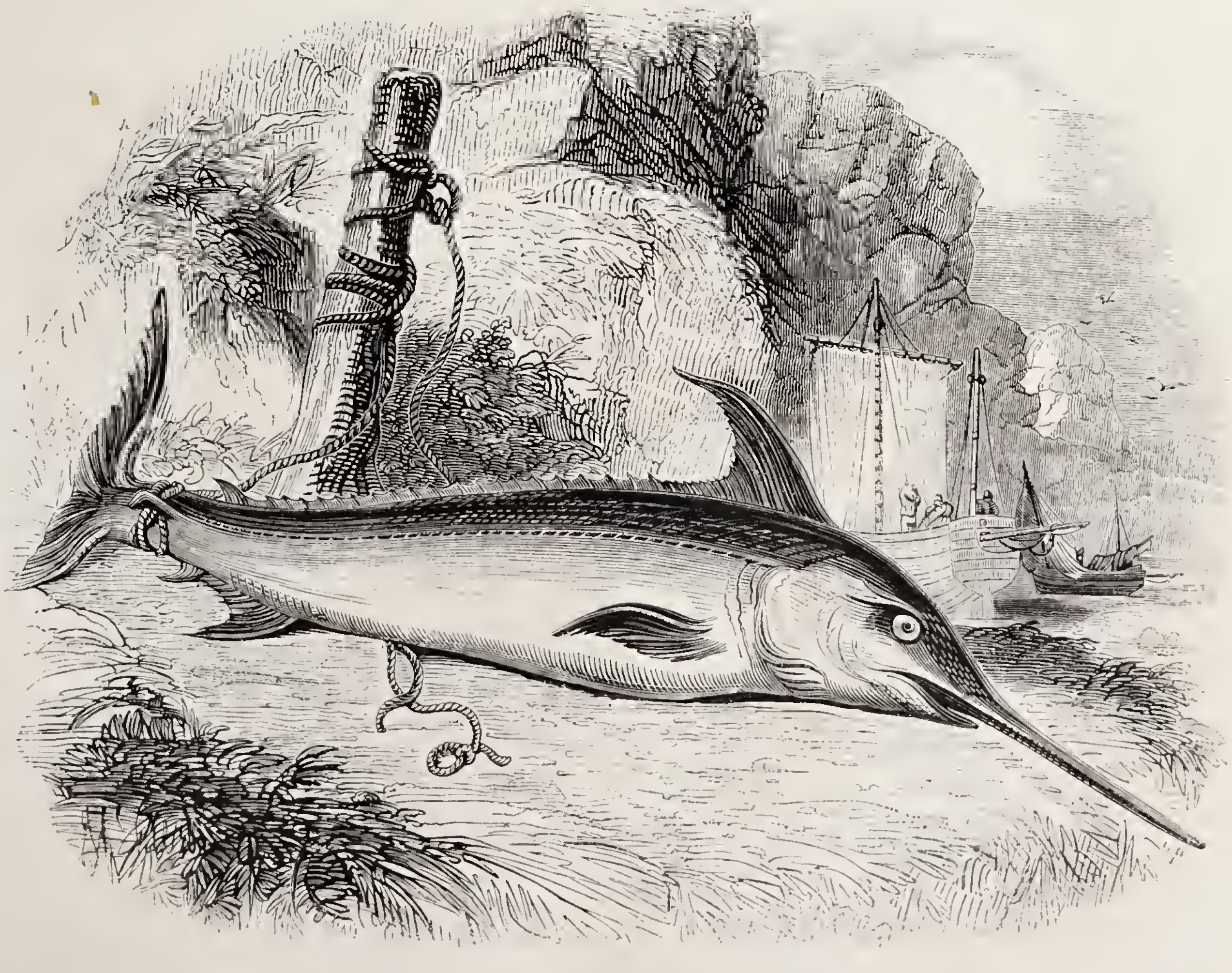
2406.—Fishing-boats off the Island of Capri



2403.—Ocellated Pteraclis.



2405.—Tusk of Sword-fish driven into timbers of a ship.



2404.—Sword-fish.

the dark through the water hang in the meshes of the net, which are large enough to admit them beyond the gill-covers and pectoral fins, but not large enough to allow the thickest part of the body to pass through. In the morning early, preparations are made for hauling the nets. A capstan on the deck is manned, about which two turns of the drift-rope are taken. One man stands forward to untie the upper edge of each net from the drift-rope, which is called casting-off the lashings; others hand in the net with the fish caught, to which one side of the vessel is devoted; the other side is occupied by the drift-rope, which is wound in by the men at the capstan." The most active period of the fishery has already been stated. The seasons fluctuate considerably, an abundant year being succeeded by a scarce one; or several of the latter may occur together, and afterwards may be compensated by successive years of plenty. On some nights two or three thousand fish will be caught by one boat, and another not more than a mile distant may not take one hundred. This uncertainty contributes to render the fishery a precarious source of subsistence to those who can only embark capital in it on a small scale, and cannot stand against the unforeseen reverses which may occur in a short period, but are counterbalanced on an average of years.

The boats employed are generally about thirty feet in the keel, built of oak or ash, and copper-fastened. They possess great depth of waist and breadth of beam, are noted for their durability, and considered as fast and safe a class of boats as are to be found in the fisheries on any coast of the United Kingdom. From Hastings to Dungeness the beach and coast are bold and rocky, and the strength of the boats is severely tested in attempting to "beach," besides the frequent loss of life; but latterly a different method has been adopted of gaining the beach, by which this object is effected in a more skilful and less dangerous manner.

As instances of the great variations of price which are experienced in this fishery, some examples, cited by Mr. Yarrell, may be quoted:—In May, 1807, the first Brighton boat-load of mackerel sold at Billingsgate for forty guineas per hundred—seven shillings each, reckoning six score to a hundred. The net boat-load produced but thirteen guineas per hundred. At Dover, in 1808, mackerel were sold at sixty for a shilling. In 1834, they were cried through the streets of London at three for a shilling. Mr. Yarrel mentions several instances of great success in this fishery. The value of the catch of sixteen boats from Lowestoffe, on the 30th of June, 1831, amounted to 5252*l.* In March, 1833, on a Sunday, four Hastings boats brought on shore ten thousand eight hundred fish, and the next day two boats brought seven thousand fish. Early in the month of February, 1834, one boat's crew, from Hastings, cleared 100*l.* by the fish caught in a single night. The fish are sold by auction on the beach; and at Billingsgate the dealers sell them in quantities above fifteen, which is the lowest number disposed of by wholesale; some dealers will not sell less than a hundred of six score. During the season about one hundred thousand mackerel are brought to Billingsgate in the course of one week. The uncertainty with regard to the commencement of the season extends to prices, and to the success of each boat, and resembles a lottery, in which there are some high prizes, and many scarcely worth striving for; but the hope of obtaining the former is the great stimulus to exertion. It is gratifying to learn that clubs are established in which the fishermen can insure their boats.

Fig. 2397 represents the crew of a French fishing-boat angling for mackerel. Fig. 2398 represents mackerel boats in the Bay of Hastings, with Beachy Head in the distance. Fig. 2399 represents a scene which may be often witnessed in a fishing town, viz. a Dutch market.

The plan is to separate the fish into heaps as soon as they are landed; and the persons desirous of purchasing being assembled, one of the fishermen or owners of the boat acts as salesman, and names a price above the real value, at the same time elevating a large stone with which to "knock down" a lot. A lot which may ultimately sell at forty shillings is offered at sixty shillings, the salesman rapidly naming a lower price until he gets a bid, when the stone descends to the ground, and the first bidder is thus the purchaser. The descending instead of an ascending scale enables the sellers to get through their work more quickly; and it is, perhaps, the fairest, for the price approaches nearer the actual worth than when feelings of rivalry are allowed to display themselves.

2400.—The Horse-Mackerel, or Scad

(*Caranx trachurus*). Scomber trachurus, Linn. In the genus Caranx the body is covered with small scales, with the exception of the lateral line, along which extends a series of broad scales, those on the posterior half of the body having an elevated keel in the centre, whence a continuous ridge is formed to the caudal fin; dorsal fins two, free abdominal spines; teeth minute. Branchiostegous rays seven.

This species is common in the British seas, and occasionally visits the coast in countless myriads, cart-loads being captured without the slightest difficulty. The flesh of the horse mackerel is of very inferior quality, hence the fish is seldom brought to market; but both this and the true mackerel are salted in the west of Cornwall for winter consumption. The shores of that county, and also of Devon, are annually visited by the present species, which arrives from the deep sea, in the beginning of May, or earlier; but it is not until the summer has advanced that the numbers are considerable. Sometimes the shoals are enormous; and upwards of ten thousand fish have been taken in a single evening. Mr. Yarrell adduces an instance of this kind which occurred at Marazion, and quotes the following account detailed by Mr. Bicheno, residing on the coast of Glamorganshire; "on Tuesday the 29th of July, 1834, we were visited by immense shoals of scad, or, as they are also called, horse mackerel. They were first observed in the evening; and the whole sea, as far as we could command it with the eye, seemed in a state of fermentation with their numbers. Those who stood on some projecting rock had only to dip their hands into the water, and with a sudden jerk they might throw up three or four. The bathers felt them come against their bodies; and the sea, looked on from above, appeared one dark mass of fish. Every net was immediately put in requisition, and those which did not give way from the weight were drawn on shore laden with spoil. One of the party who had a herring-seine with a two-inched mesh was the most successful; every mesh held its fish, and formed a wall that swept on the beach all before it. The quantity is very inadequately expressed by numbers, they were caught by cart-loads. As these shoals were passing us for a week, with their heads directed up channel, we had the opportunity of noticing that their feeding time was morning and evening; they were pursuing the fry of the herring, and I found their stomachs constantly full of them."

This species is found in the Mediterranean, and occurs also on the coast of Norway and Denmark. The general colour above is olive changing to a brilliant green, waved with a gloss of blue; the sides of the head, and the under parts, are silvery white with waved reflexions; a spot on the gill-covers, and the throat, black.

2401.—The Dorado, or Dolphin

(*Coryphæna Hippurus*). In the genus Coryphæna the body is elongated, compressed, and covered with small scales, the head is trenchant above, the profile abrupt and curved; a single dorsal fin with flexible rays extends along the back; there are palatal as well as maxillary teeth. Branchiostegous rays seven.

This brilliant fish, celebrated from the earliest times for its beauty and its rapidity, must not be confounded with the dolphin, or delphinus, one of the cetacea, though it bears the same name. It is common in the Mediterranean, and the warmer latitudes of the ocean, making incessant war upon the shoals of flying-fish, which, in common with the Bonito, it chases for prey. In the water the lustre of this species, and the mingling of the tints which adorn it, render it very engaging; it is of a silvery blue above, with markings of a deeper tint; the under parts are citron yellow, spotted with light blue. After death its rich and burnished hues fade and disappear.

It is the poet's

> "—— Dolphin, whom each pang embues
> With a new colour as it gasps away,
> The last still loveliest, till 'tis gone, and all is grey."
>
> Byron.

2402.—The Starred Coryphæna

(*Astrodermus Coryphænoides*). This fish is also a native of the Mediterranean, and measures from twelve to eighteen inches in length; it is of a pale rose colour, with five or six longitudinal rows of round black spots: the pectoral and caudal fins are red, the others dusky. The mouth of this species is small, but the most remarkable character consists in the arrangement of the scales, which, instead of lapping over each other in the usual way, are scattered over the head and body; they are very minute, and under a lens resemble stars; a cluster of four is represented under the tail of the figure.

2403.—The Ocellated Pteraclis

(*Pteraclis ocellatus*). This singular fish is remarkable for the great expansion of the dorsal and opposite fins, while the pectoral and ventral fins are small, more particularly the latter. These expanded fins spring from between two tiers of scales which give strength to the base of the rays. The scales are large.

This species is about four inches long, and of a silvery hue; the pectoral and caudal fins are yellowish, the others bluish grey; the dorsal fin has a round dark blue spot near its anterior angle. It is said to be a native of Carolina. Cuvier says, "Bosc nous assure l'avoir pris à la Caroline; Pallas dit le sien des Moluques; peut-être sont-ce deux espèces."

2404.—The Sword-fish

(*Xiphias Gladius*). Xiphias Imperator, Schn. In the genus Xiphias the upper jaw is elongated into a formidable spear, the only weapon, for the mouth is without teeth. The body is fusiform, and covered by minute scales, the dorsal fin is single and elevated, ventral fins are wanting, the tail is strongly carinated. Branchiostegous rays seven.

This formidable fish, which was well known to the ancients, is a native of the Mediterranean, where it is common; it does not, however, confine itself to that sea, but passing through the Straits of Gibraltar into the wide ocean, takes either a northward or a southward course, seldom continuing its direction westward. It has been found along the coast of Europe as far as the Baltic, and along that of Africa to the Cape of Good Hope. Captain Beechey met with it near Easter Island in the Pacific. This species was first noticed in our seas by Sibbald, and subsequently many naturalists have had opportunities of examining specimens taken along the coast of Scotland. In 1834, a dead sword-fish ten feet long was found on the Essex coast; and Daniel, in his 'Rural Sports,' relates that "in the Severn near Worcester a man bathing was struck and absolutely received his death-wound from a sword-fish; the fish was caught immediately afterwards, so that the fact was ascertained beyond a doubt." The sword-fish attains to the length of twelve and even fifteen feet, and is prodigiously active and powerful; it is said to go in pairs. Its food consists of fish, cuttle-fish, &c. It is said to be a great enemy to the tunny, a fish of the Mediterranean (Thynnus vulgaris) celebrated for the excellence of its flesh. Belon affirms that the shoals of tunnies are as much alarmed at the appearance of a sword-fish, as a flock of sheep at the sight of a wolf. It pursues them with great pertinacity, and transfixes them with its spear.

In the Mediterranean the fishery of this formidable species is regularly practised by the fishermen of Sicily, Capri, and other places, for in many places it is esteemed as an article of food, especially by the Sicilians, who buy it up eagerly at any price at the commencement of the season, which lasts from May to August. They cut it into pieces, and salt it for future use. This process was in ancient times particularly performed at the town of Thuri in the bay of Tarentum, whence the fish was called Tomus Thurianus. A description of the ancient manner of taking this fish has been left us by Strabo, from which it appears that the process was the same as that now in use. A man mounts upon a cliff that overhangs the sea; and as soon as he discovers the fish, gives notice to a boat in attendance of the course it has taken. A man in the boat then mounts the mast, and on seeing the sword-fish directs the rowers towards it. As soon as they think themselves within reach, the man on the mast descends, and taking in his hand a harpoon, to which a cord is attached, strikes it into the fish, sometimes at a considerable distance. After being wearied with its agitations and attempts to escape, as well as exhausted by its wound, the fish is seized and drawn into the boat. The operation has considerable resemblance to the whale fishery on a small scale. The superstitious Sicilian fishermen have an unintelligible chant, which they regard as a most essential part of their apparatus. Brydone thinks it is Greek; but be that as it may, the fishermen are convinced of its efficacy as a charm, its operation being to attract and detain the fish near the boat. There are certainly some Italian words in it, although it is said that the men believe that the fish would dive into the water and be seen no more if it happened to hear a word of Italian.

The reported hostility of the sword-fish to the whale, which it attacks with fury, seems to have some foundation. Captain Crow, in a work published lately, gives the following fact as having been witnessed by himself during a voyage to Memel. "One morning, during a calm, when near the Hebrides, all hands were called up at three A.M. to witness a battle between several of the fish called thrashers or fox-sharks (Carcharias Vulpes) and some sword-fish on one side, and an enormous whale on the other. It was in the middle of summer, and the weather being clear, and the fish close to the vessel, we had a fine opportunity of witnessing the contest. As soon as the whale's back appeared above the water, the thrashers springing several yards into the air, descended with great violence on

the object of their rancour, and inflicted upon him the most severe slaps with their long tails, the sound of which resembled the reports of muskets fired at a distance. The sword-fish in return attacked the distressed whale, stabbing from below; and thus beset on all sides and wounded, when the poor creature appeared, the water around him was dyed with blood. In this manner they continued tormenting and wounding him for many hours, until we lost sight of him; and I have no doubt they in the end completed his destruction." It is a well established fact that this species of sword-fish, and another of still more gigantic size found chiefly in the Indian and Brazilian seas, Istiophorus platypterus* (Xiphias platypterus, Shaw), often drive violently against vessels, mistaking them as it is supposed for whales.

The captain of an East Indiaman sent to Sir Joseph Banks an account of an astonishing but not singular instance of the strength of an individual of this broad-finned species: the bottom of his ship was pierced through by its sword in such a manner that it was completely imbedded, or driven through almost to its base,—the animal having been killed with the violence of the shock. It is a fortunate circumstance that the fish is generally either killed in this manner or else perishes from being unable to withdraw its weapon, for could it effect this object, the vessel must inevitably founder in consequence of the leak; and indeed instances are recorded in which some vessels, probably old or of a slight description, have been greatly endangered, or even lost, in consequence of having been struck by a sword-fish. In the present instance, the wood, with the sword imbedded in it, was sawed out, and is now in the British Museum.

Pliny mentions the power of the sword-fish to transfix vessels; and this was for a long time regarded as one of the exaggerated statements which are so common in the works of the ancient naturalists. Dr. Shaw thinks that Pliny, not being acquainted with the distinction of species, must have attributed to the common sword-fish what is true only of this species; but the operation seems to be as often performed by the common fish as by that with the broad fin.

Dr. Jerome V. C. Smith, in his history of the fishes of the Massachusetts, 1833, narrates the following:

"On a calm sunny day during the last summer, as a pilot was leisurely rowing his little skiff over the glossy bosom of the gently-swelling waves, he was suddenly roused from his seat by the plunge of a sword-fish, thrusting his long spear more than three feet up through the bottom of his slender bark, when the pilot, with that presence of mind for which the whole fraternity are distinguished, broke it off on a level with the floor, by the butt of an oar, before the submarine assassin had time to withdraw his fearfully offensive weapon.

"Within five or six years, a Boston ship, on a return from a long voyage, being over-hauled for repairs, presented the stump of a sword-fish's blade, the point of which was driven a considerable way into the hard oak. In repairing his Britannic Majesty's ship Leopard, in 1725, on her return from the coast of Guinea, a sword of this fish was found to have gone through the sheathing one inch, next through a three-inch plank, and beyond that four inches and a half into the firm timber. It was the opinion of mechanics that it would require nine strokes of a hammer, weighing twenty-five pounds, to drive an iron bolt of similar size and form to the same depth in the same hull; yet this was accomplished by a single thrust."

That the vessel came from the coast of Guinea is certainly one circumstance in favour of the claim of the common fish to the credit of this feat.

"The Hon. Josiah Robbins," proceeds Dr. Smith, "of Plymouth (United States), related to us the following extraordinary fact. On the return of the ship Fortune, of Plymouth, from a whaling voyage in the Pacific, some time in the year 1826 or 1827 (he does not recollect which), the stump of a sword-blade was discovered on the outside of the hull, which, on examination, was found to have penetrated through the copper sheathing, an inch-board sheathing, a three-inch plank of hard wood, the solid white oak timber of the ship, twelve inches thick, through another two and a half inch hard oak ceiling plank, and lastly perforated the head of an oil cask, where it still remained immovably fixed, so that not a single drop of oil had escaped."

* The broad-finned sword-fish (Istiophorus platypterus) is of a thinner and more elegant form than the ordinary species, and is also distinguished by an extremely broad back fin, and by very long sharp-pointed thoracic appendages, which are entirely wanting in the other. The general colour of the fish is of a silvery-bluish white except on the back, head, tail, and fins, which in the living animal are of a deep blue, fading into brown in the dried specimens. This fish is found in the Brazilian and East Indian seas, and also in the Northern seas, where and elsewhere it is a great enemy to whales, piercing them with its formidable weapon. A specimen of this fish occupies a very conspicuous situation at the British Museum in a distinct case, which also contains three specimens of detached swords. In the same room there is a small specimen of the common sword-fish.

Fig. 2405 will serve to illustrate the above anecdotes, being copied from a specimen in the Adelaide Gallery of the weapon of a sword-fish thus run through the outer and inner timbers of a copper-sheathed vessel. Such evidence seems almost needful to render credible the accounts given of the astonishing strength of this formidable creature.

Fig. 2406 represents the picturesque island of Capri, in the Mediterranean, celebrated for its fish, its flights of quails, its wine, and its antiquities. The fishing-boats have high pointed prows.

Family MUGILIDÆ (THE GREY MULLETS).

The Grey Mullets and the Red Mullets belong to different families; the latter to the Percidæ. The former constitute the type of a distinct group, with the following general characters: the body is almost cylindrical, covered with large scales; there are two dorsal fins, separated from each other, of which the first has only four spinous rays; the ventral fins are seated posteriorly to the pectorals; the branchiostegous rays are six; the head is depressed; the muzzle is very short; the mouth presents an angle produced by a bold prominence at the apex of the lower jaw, received into a corresponding notch of the upper; the teeth are minute.

The Mugilidæ, says Cuvier, are "excellent fishes, which, in troops, enter the mouths of rivers, taking great leaps out of the water; our seas produce several species as yet not well determined."

2407.—THE GREY MULLET

(*Mugil Capito*, Cuv.). This species, confounded by Linnæus with the Mugil Cephalus, is an inhabitant not only of the Mediterranean, but also of the western shores of temperate Europe. It is common along our southern coast, and that of Essex, and is found also along many parts of the Irish coast; it occurs in the Baltic.

Mr. Couch, a gentleman who paid much attention to the habits of fish on the shores of Cornwall, communicated the following interesting facts respecting the grey mullet to Mr. Yarrell:—"The fish never goes to a great distance from land, but delights in shallow water when the weather is warm and fine; at which time it is seen prowling near the margin in search of food, and imprinting a ripple on the placid surface as it snatches beneath any oily substance that may be swimming. It ventures to some distance up rivers, but always returns with the tide. Carew, the Cornish historian, had a pond of salt water, in which these fish were kept; and he says that having been accustomed to feed them at a certain place every evening, they became so tame that a knocking like that of chopping would certainly cause them to assemble. The intelligence this argues may also be inferred from the skill and vigilance this fish displays in avoiding danger, more especially in effecting its escape in circumstances of great peril. When enclosed within a ground-sean, or sweep-net, as soon as the danger is seen and before the limits of its range are straitened, and when even the end of the net might be passed, it is its common habit to prefer the shorter course, and throw itself over the head-line and so escape; and when one of the company passes all immediately follow."

The grey mullet will rise freely at flies, like the trout, and affords good sport to the angler, as it is a vigorous fish and requires skilful management. It feeds upon soft and unctuous substances, and is often seen thrusting its mouth into the mud in search of small decomposing morsels, for the selection of which its lips appear to be endowed with a high sense of taste. It avoids large and hard substances, and will often take the bait between its lips and immediately reject it if suspicion be at all excited. The best bait for ordinary fishing, according to Mr. Couch, is a small bit of the fat intestine of a fish, or cabbage boiled in broth. Midsummer is the breeding season of this species.

Mr. Yarrell, alluding to the old proverb, that the county of Sussex is celebrated for six good things, gives as one the Arundel mullet. The town of Arundel, on the Arun, is ten miles from the sea, and, he continues, "during the summer of 1834, probably owing to the warmth of it, the grey mullet migrated much farther up the river than usual, and numbers were caught above even where the spring tides flow, as high up as Amberg Castle, which is by the river nearly ten miles above the town of Arundel, and nearly twenty miles from the sea."

That the grey mullet will not only live entirely in fresh water, but even thrive, has been proved by Mr. Arnould, who put a number of the fry into his pond at Guernsey, covering about three acres; and a few years afterwards mullet of four pounds weight were caught, fatter, deeper, and heavier, for their length, than those obtained from the sea.

The colour of this species above is dusky bluish grey, passing into silvery white on the sides and belly, marked with parallel longitudinal dusky lines; irides reddish brown; pupil black.

Family GOBIADÆ (BLENNY, GOBY).

In this family the dorsal rays are slender and flexible; and there is no swimming bladder.

2408.—THE OCELLATED BLENNY, OR BUTTERFLY-FISH

(*Blennius ocellaris*). The Blennies are remarkable for their blunt and rounded head, and for their single long dorsal fin; the ventral fins are placed before the pectoral, and are generally composed of only two rays united at the base. The teeth are slender and in a single row. Five species frequent our coasts. The Ocellated Blenny was first described as a British fish by Montagu, who obtained three specimens from the southern coast of Devon; the specimen figured by Mr. Yarrell was obtained among the rocks about the Isle of Portland. This species, which appears to be of rare occurrence on our shores, is scarcely three inches in length; its short round head is furnished with two slender fimbricated appendages above the eyes, which latter are large with a golden iris. The skin of the head is loose, and here and there studded with small warty papillæ. The general colour is pale brown, with darker patches, and a dark rounded spot is on the anterior part of the dorsal fin, the first ray of which is elongated.

Formula of the fin rays:—D. 26, P. 12, V. 2, A. 17, C. 11.

This singular little fish, remarkable for the development of its dorsal fin, is common in the Mediterranean; it haunts spots covered with sea-weed, and feeds on minute crustaceans and mollusks.

2409.—THE GEMMEOUS DRAGONET

(*Callionymus Lyra*). The Dragonets have a tapering depressed head, with the eyes on the upper surface and close together; there are two dorsal fins, considerably elevated; the first ray of the first fin strong and elongated; the ventral fins exceed the pectoral; the mouth is capable of great protrusion, and furnished with numerous small teeth on the maxillary bones only. Gill aperture very small; branchiostegous rays six. This brilliant fish is rather rare on our coasts, and appears to frequent deep water, keeping close to the bottom; it is found in the Mediterranean, and, according to Nilsson, on the coast of Norway. Its food consists of crustacea and shelled mollusks. The length of this species is ten or twelve inches; the skin is smooth; the head is spotted and striped with blue on a yellowish ground. The prevailing colour of the body is a glossy golden yellow, whence its name of Yellow Skulpin in Cornwall, and Gowdie in Scotland. The first dorsal ray reaches to the extremity of the body. The dorsal fins are pale brown, with darker longitudinal bands; the other fins are bluish black.

Family LABRIDÆ (WRASSES, or ROCK-FISHES).

The Labridæ have an oblong scale-clad body, and a single dorsal fin, the anterior portion of which is sustained by spinous rays, each garnished at the tip, at least in general, with a little membranous filament; the lips are large and fleshy; the teeth are conspicuous and strong; the swimming bladder is large.

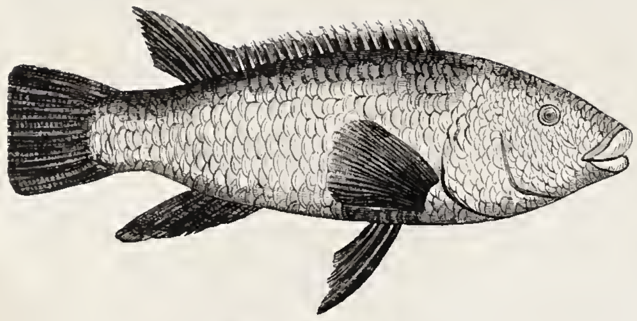
2410.—THE BALLAN WRASSE

(*Labrus maculatus*). In the genus Labrus the scales are large and thin, and cover the cheeks and operculum; the lips are very fleshy; the teeth conical and sharp; tail rounded.

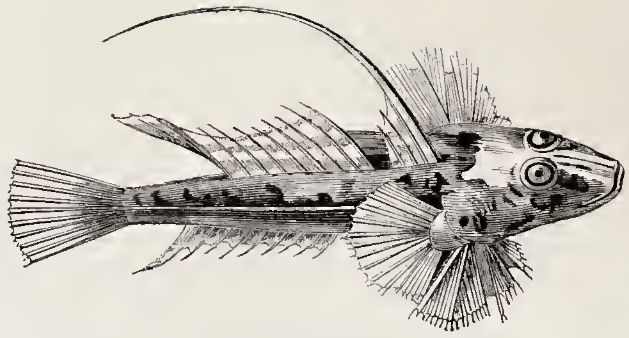
The Ballan Wrasse haunts submarine rocks off our coast and that of the adjacent continent. It has been taken also on the coast of Ireland. It feeds on various kinds of crustacea, and, according to Mr. Couch, takes a bait freely: the fishermen, he says, remark that when they first fish in a place they take but few, and those few of large size, but on trying the same spot a few days afterwards they catch a greater number, and those smaller, whence they conclude that the large fish assume the dominion of a district and keep the younger at a distance. They breed in April, and the young are seen swimming about the rocks in clear shallow water during the summer.

The flesh of the Ballan Wrasse is soft and worthless; in beauty of colouring, however, this fish is exceeded by few. The head and cheeks are of a rich deep bluish green, reticulated with lines of fine orange red. The back and sides are of a deep bluish green, becoming paler on the belly; and every scale is margined with orange red. The fins are spotted with verditer, the fin rays being reddish orange. Lips flesh colour. Length from sixteen to twenty inches.

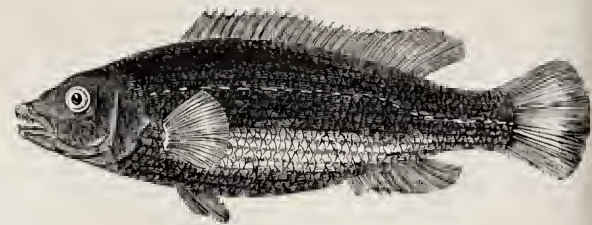
A fine specimen of this beautiful fish some years ago came under our immediate notice. When put into spirits, for the sake of preservation, its fine blue



2410.—Ballan Wrasse.



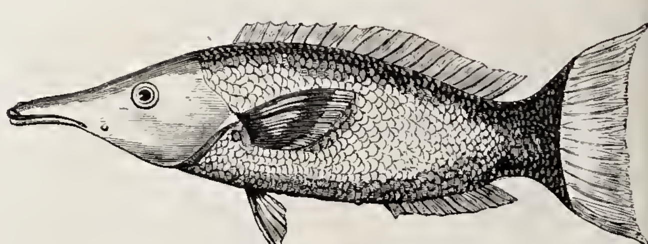
2409.—Gemmeous Dragonet.



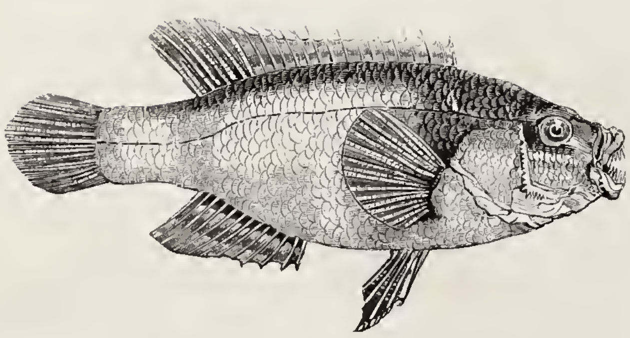
2411.—Green-streaked Wrasse.

2408.—Butterfly-fish.

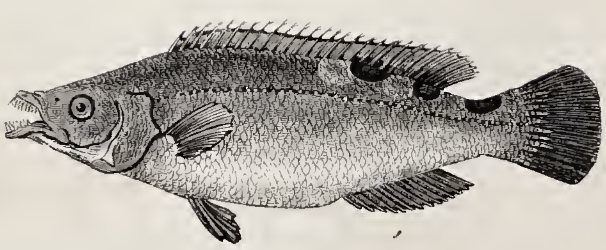
2407.—Grey Mullet.



2416.—Ceylonese Green Wrasse.

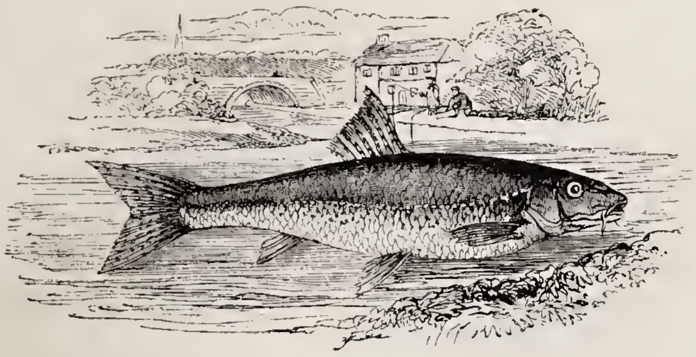


2415.—Gilt-head or Golden Maid.

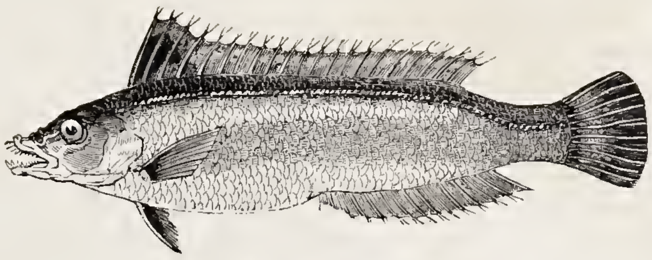


2412.—Red Wrasse.

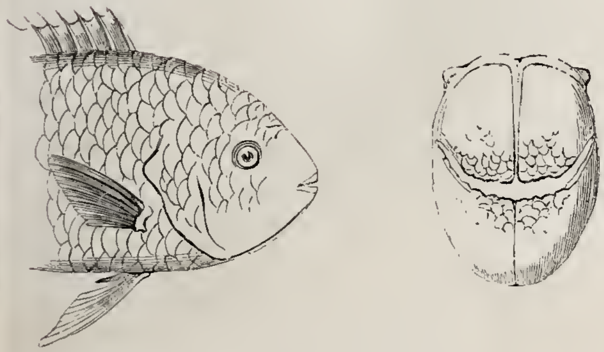
2414.—Goldfinny.



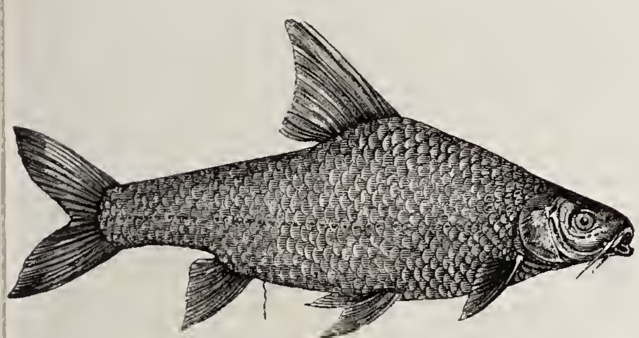
2421.—Gudgeon.



2413.—Rainbow Wrasse.

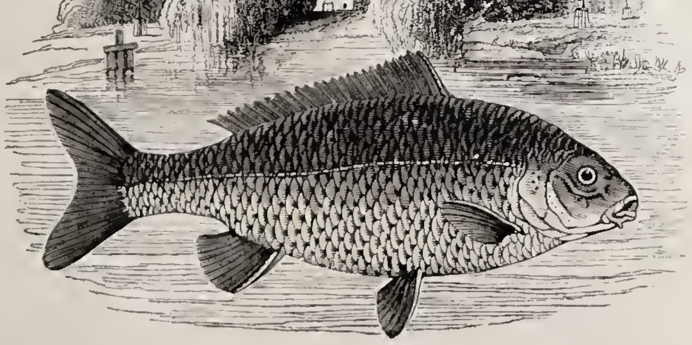


2417.—Head and Mouth of Parrot-fish.

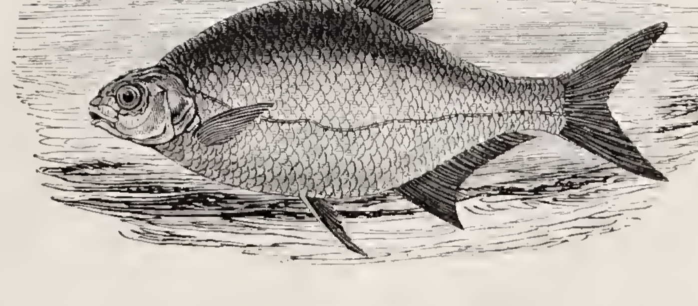


2420.—Barbel.

2419.—Carp.



2418.—Carp.



2422.—Bream.

tints began rapidly to fade; and the colouring matter being dissolved by the spirits, rendered the liquor blue. In a few days the fish had lost its splendour, so that no idea could have been formed from its appearance of its original colours.

This species is subject to some variety. A specimen taken in January, 1831, in Swansea Bay, was red, becoming pale orange on the belly; the body ornamented with bluish green oval spots; the fins and tail green, with a few red spots; the dorsal fin had spots along the base only. (See Yarrell.) The specimen which came under our notice (see 'Zool. Proceeds.,' Dec. 1830, p. 17) was marked with orange, as described, on a deep rich blue.

2411.—The Green-streaked Wrasse

(*Labrus lineatus*); Labrus Psittacus, Risso.

This species is found in the Mediterranean, and occasionally visits the coast of Cornwall and Devonshire. It is so rare a species that Mr. Yarrell states that he has never seen either a British or Mediterranean specimen. Donovan described it from an individual seven inches in length, taken on the Cornish coast by Captain Bray; and Colonel Montagu states in his MS. that he had captured it on the coast of Devonshire. According to M. Risso this species is of an elongated form, and of a fine meadow green colour, lighter on the sides, and yellowish green on the throat and under parts. The operculum is angular: the female is of a uniform green above, silvery beneath.

2412.—The Red or Three Spotted Wrasse

(*Labrus carneus*). The Red Wrasse is common in the Mediterranean, and occasionally visits our coast, having been taken off Anglesey and the coast of Devonshire and Cornwall, as well as in the Frith of Forth. It is enumerated among the fishes of the Baltic and the coast of Norway.

Its food consists of crustaceans and mollusks, which it seeks among the rocks, under the long floating seaweed of which it finds shelter, and concealment. Muller says that its flesh is good.

The present species is of a fine red orange, paler on the sides, and fading into light orange yellow underneath. The fins are orange, fringed with a deeper tint, but part of the anterior spinous portion of the dorsal fin is of a rich purple; and two rounded spots of the same colour, alternating with two of a delicate rose tint, are seated on the back, on each side of the soft part of the dorsal fin, while a rose spot and purple spot occupy the ridge of the fleshy portion of the tail.

2413.—The Rainbow Wrasse

(*Julis Mediterranea*); Labrus Julis, Linn.

In the genus Julis, the head is smooth, the cheeks and gill-covers without scales; the lateral line bends suddenly down when opposite the end of the dorsal fin. Other characters as in Labrus.

This species inhabits the Mediterranean, frequenting the most rocky shores; occasionally it is found on the coast of Cornwall. In habits and manners it agrees with the Wrasse tribe generally.

It is very beautiful; the back is greenish blue, the longitudinal line is orange, beneath that are lilac bands on a silvery ground: the head is varied with brown, yellow, blue, and silver; the dorsal fin is orange, with a purple anterior spot, the three first spinous rays are longer than the others.

2414.—The Goldfinny or Goldsinny

(*Crenilabrus Cornubius*).

The genus Crenilabrus is distinguished from Labrus, by the denticulation on the edge of the præoperculum. The Goldfinny is found in the Mediterranean, and also along the coast of Devonshire and Cornwall, and as far east as Beachy Head. It has been taken on the coast of Ireland. The lateral line of this species deflects opposite the end of the dorsal fin, and then runs to the tail, dividing it equally. "This fish," says Montagu, "varies in colour, but is generally more or less green or yellowish, darkest on the back; the sides generally marked with longitudinal darker lines mostly green, but sometimes not very conspicuous; a dark spot at the base of the caudal fin, on the lateral line, appears to be a constant specific character." This species haunts rocks where nets are rarely cast, and as it refuses to take a bait, is seldom to be procured. It is generally captured in the wicker traps set to catch lobsters and crabs. Length from three to five inches.

2415.—The Gilt-head or Golden Maid

(*Crenilabrus Tinca*). On most of the rocky parts of our southern and western coast, and in many parts of the coast of Ireland, the Gilt-head is tolerably common; and, like the goldfinny, is usually taken by fishermen, in the lobster-pots, attracted by the tempting morsels, intended as a lure to those valued crustacea. Its figure is thick; its head large; its teeth prominent. The head is blue, striped and spotted with orange red. The body is red, varied with green; all the fins are greenish blue, some having a stripe or two of a darker tint. Length six or seven inches. Mr. Yarrell states, that this is the Ancient Wrasse, and Common Wrasse of authors, who describe a blue and yellow species with a denticulated præoperculum; but not of Pennant and others, which is identical with the Ballan Wrasse.

2416.—The Ceylonese Green Wrasse

(*Gomphosis viridis*). In the genus Gomphosis the muzzle is greatly produced and slender, and the head is smooth; the mouth is small; the tail ample, and somewhat lunate. All the species inhabit the Indian seas, and some are great delicacies for the table. In their habits, they resemble the Wrasses generally. The present species is found along the coast of Ceylon; it is of a dark green, the pectoral fin having a black transverse mark.

Within the limits of the present family, may be noticed a group of fishes (Scarus, Linnæus), generally known by the name of Parrot-fishes, remarkable for the convex and rounded form of the jaws, which are beset with several series of scale-like teeth, so soldered together, that they usually appear to form solid masses of enamel; these teeth succeed each other from behind, forwards; those at the base behind, being the most recent in formation, in time replace those anterior to them, and form themselves the cutting edge. When alive, the fleshy lips nearly cover the teeth. Fig. 2417 shows the Head of a Parrot Fish, and also a front view of the Beak-like Mouth, seen anteriorly, and of the natural size.

In general form, and in the large scales with which the body is covered, these fishes resemble the true Wrasses, and, as in the latter, the bones of the pharynx are furnished with teeth. These fishes are mostly confined to the hotter latitudes, and are of the most brilliant colours, from which circumstance, combined with a fancied resemblance of the mouth to the beak of a parrot, they have obtained their common appellation.

One fish of this group, the Scarus creticus of Aldrovandus, was in high repute among the Romans. It is of a blue or red colour, according to the season, and is found in the Greek seas. It was for this fish, that a Roman fleet, in the reign of Claudius, was dispatched under Elipertius Optatus, in order that it might be transported to and acclimatized in the Italian sea. It is eaten at the present day in Greece, served up with a sauce of its "trail." See Cuvier.

ORDER MALACOPTERYGII.

SECTION ABDOMINALES.

The abdominal malacopterygious or soft-rayed fishes are those in which the ventral fins are suspended under the abdomen far posterior to the pectoral fins, and without being attached to the shoulder bones of the latter. In this section is comprehended the greatest number of freshwater fishes.

Family CYPRINIDÆ (CARPS, GUDGEONS, DACE, &c.).

In this family the fissure of the mouth is small, the jaws weak, mostly destitute of teeth, while on the contrary the pharynx is furnished with strong teeth. The branchiostegous rays are few, the body is covered with scales.

2418, 2419.—The Carp

(*Cyprinus Carpio*). In the genus Cyprinus, the body is protected by large scales: there is a single elongated dorsal fin; the lips are fleshy; pharyngal but not maxillary teeth; branchiostegous rays three.

This beautiful fish, rich with burnished gold, is not an original of our country, common as it is in our ponds, lakes, and rivers, but was, at some period not ascertained, introduced into our island from the continent, where it is widely spread. Mr. Yarrell says, "Leonard Mascall takes credit to himself for having introduced the carp, as well as the pippin; but notices of the existence of the carp in England occur prior to Mascall's time, 1600. In the celebrated 'Boke of St. Albans,' by Dame Juliana Barnes or Berners, the Prioress of Sopewell Nunnery, printed at Westminster, by Wynkyn de Worde, in 1496, carp is mentioned as a "deyntous fisshe;" and in the privy purse expenses of King Henry VIII., in 1532, various entries are made of rewards to persons for bringing "carpes to the king."

The carp is very prolific, and prefers ponds and lakes with a muddy bottom to clear rivers, in which it is the opposite of the trout. In favourable waters often it attains to an enormous size. Daniel, in his 'Rural Sports,' says that "Mr. Ladbroke, from his park at Gatton, presented Lord Egremont with a brace that weighed thirty-five pounds, as specimens to ascertain whether the Surrey could vie with the Sussex carp." Mr. Yarrell adduces two instances, in one of which a carp taken at Stourhead was thirty inches long, upwards of twenty-two broad, and eighteen pounds in weight; the other is that of a carp taken from the White-Sitch Lake, at Weston Hall, Staffordshire, the seat of the Earl of Bradford, which weighed nineteen pounds and a half; a painting of it is preserved. The growth of the carp, however, is not very rapid, yet it would appear that some have attained a weight of three pounds by their sixth year, and of six pounds before their tenth year.

The breeding time of this fish is towards the end of May or at the beginning of June: Bloch found six hundred thousand eggs in the roe of a female of nine pounds weight.

Few fish are more tenacious of life, out of the water, than the carp; in wet moss they will live for weeks, and in some parts of the continent they are thus kept, refreshed occasionally by water thrown over them, and the moss freely saturated; while thus mewed up, they are fed upon bread steeped in milk.

In the winter, carp appear to undergo a partial state of torpor, burying themselves in the mud, or in deep holes under the bank. White, in his 'Natural History of Selbourne,' says, "In the Garden of the Black Bear Inn, in the town of Reading, is a stream or canal, running under the stables, and out into the fields on the other side of the road. In this water are many carps, which lie rolling about in sight, being fed by travellers, who amuse themselves by tossing them bread. But as soon as the weather grows at all severe, these fishes are no longer seen, because they retire under the stables, where they remain till the return of spring." The carp is in season from October to April: its flesh has been much praised, but we think undeservedly; it is not to be compared to that of the tench. Boccius says that those which are more than twenty years old are hideously coarse; and Mr. Yarrell considers it more indebted to the cook for the estimation in which it is held, than its intrinsic flavour. Isaac Walton seems to have been of the same opinion, notwithstanding that he calls this fish the "queen of rivers."

Carp are said to live to a hundred and fifty or two hundred years old, but they lose their fine colour and become grey. Worms, the larvæ of insects, and soft aquatic plants are their food.

The first dorsal fin ray is short, stout, and bony; the second also is bony and strongly serrated behind; the other rays are flexible; the first ray of the last fin below is also bony, strong, and serrated posteriorly, it consists of two slips soldered together. Two small barbules at each corner of the mouth.

The beautiful gold fish from China (Cyprinus auratus) is an allied species.

2420.—The Barbel

(*Barbus vulgaris*); Cyprinus barbus, Linn. In the genus Barbus, the dorsal fin is short, with the first ray strong, bony and serrated; mouth with four barbules, two near the point of the nose, and one on each side at the angle of the mouth.

The barbel is a native of the rivers of the warmer parts of Europe, and is very common in the Thames, from Putney upwards; and is also found in the River Lea, in Essex.

In the summer, barbel frequent the weedy parts of the river in shoals, and retire on the approach of winter to deeper waters, often sheltering themselves under steep banks, the wood-work of artificial falls, old sunken boats, and the like, crowded together in dense masses; they are then easily taken by means of a net. As the weather becomes cold, they sink into a torpid state, and may be captured by the hand, without any resistance. Their flesh, however, is worthless. In summer, the barbel affords excellent sport to the angler; it will bite at worms; and requires a strong rod and line, as it is very vigorous. It is often taken by anglers, when trolling with bleak or minnows, for large Thames trout.

So numerous are barbel at Shepperton and Walton, that, according to Mr. Yarrell, a hundred and fifty pounds weight have been caught in five hours, and on one occasion, it is said that two hundred and eighty pounds weight of large sized barbel were taken in one day. He adds, that the largest fish he can find recorded, weighed fifteen pounds and a half.

In searching for food, the barbel turns up the mud with its snout, and bores into the loose soil, in quest both of vegetable aliment, and mollusks, worms, the larvæ of aquatic insects, &c. It breeds in May and June.

In its habits the barbel is shy and retiring. Mr. Jesse, describing the manners of various fishes kept in a vivarium, says, that of all the barbel were the shyest and most impatient of observation: they are notwithstanding very playful; "in the spring, when they could not perceive any one watching them,

they would roll about, and rub themselves against the brick-work, and show considerable playfulness." The general colour of this fish above is greenish brown, assuming a yellow tinge on the sides, and passing into white beneath; the sides of the muzzle and the gill-covers are tinged with bronze; the dorsal and caudal fins are brown, the rest fleshy red. The tail is forked, the muzzle long, the head wedge-shaped; the upper jaw exceeds the under, which is short; the upper lip is fleshy, and doubtless endowed with considerable sensibility, to which probably the barbules contribute.

2421.—The Gudgeon

(*Gobio fluviatilis*). Cyprinus Gobio, Linn.

The genus Gobio has the dorsal fin short, and the angles of the mouth furnished with barbules, but is destitute of the strong serrated bony ray of the dorsal and last under fin, as seen in the carp.

This pretty little fish is very common on the continent and in our island, frequenting clear rivers and streams, where it swims about in shoals, displaying considerable alertness. It feeds on worms, aquatic insects and their larvæ, small mollusks, &c. In the Thames, the Kennet, the Mersey, and Avon, the gudgeon is particularly abundant; and to those who like to pull out fish one after another, with the utmost dispatch, gudgeon fishing affords excellent sport, for no fish bites more freely, and the small red worm is a captivating bait.

Small as this fish is, seldom exceeding six or seven inches, its flesh is very delicate, and as weight can be made up by numbers, it forms an excellent dish. In the Thames the fishermen enclose shoals of gudgeons in their casting nets with small meshes, and keep them in their well-boats alive for sale; and many of the fishmongers preserve them in tanks or cisterns, supplying them with fresh water.

The breeding time of the gudgeon is in May; the shoals then seek shallow water, exposed to the sun; in a short time the young are hatched and may be soon after seen swimming about, near the margin of the stream, in many a mazy curve, and darting away when alarmed into deeper retreats. To the pike, trout, and perch, &c., the gudgeon offers a perpetual repast.

A detailed description of this fish is needless.

2422.—The Bream

(*Abramis Brama*). In this genus there are neither bony rays nor barbules; the body is deep and compressed, forming an oval outline; the dorsal fin is short, the posterior fin below long.

The bream is common on the continent as far north as Norway and Sweden, inhabiting rivers and lakes. In our island it is local. It exists in the Mole, and the Medway, the Trent, and also in other rivers that are slow and deep; as well as in canals, and extensive ponds, where it is often very abundant. The lakes of Cumberland and Westmoreland, and many of the Irish lakes, abound with bream of a large size, many weighing from ten to fourteen or fifteen pounds. The flesh is not held in much estimation, but is said to be best in spring and autumn. Formerly, indeed, it appears to have been in high request, and we believe is still esteemed on the continent, where freshwater fish are more valued than in our island, which enjoys an ample supply of sea-fish, not only around the coast, and in the metropolis, but (such is the rapidity of carriage-conveyance) even in the most central counties.

If we may credit Daniel, bream fishing must afford excellent sport to the angler, as the fish bites eagerly and plays vigorously. He thus describes a day of bream-fishing at New Hall Pond in Essex. "The weather was cloudy, and the wind brisk; there were seven rods used by the party, and very frequently there were bites at them all at the same time. When a fish was hooked, and played at the top, or near the surface of the water, numbers were seen to follow him, and so soon as the hooks were fresh baited, were alike greedily taken. Some few perch and tench were caught, but principally bream, which averaged at least two pounds a fish; and of these, from six in the morning till dark in the evening, some hundredweight were taken. The bait used was the large red worm, and the spot had been baited on the morning and evening previous to the day of fishing; the ground-bait used, was boiled wheat and tallow-melters' greaves mixed together." The bream herd together in large shoals; in the lakes of Ireland several hundredweight have been taken in a short time; the peasantry split and dry them, and thus preserve them for food.

The breeding season of this fish is May.

The general colour of the bream is golden brown; the cheeks and gill-covers silvery white; the fins are pale with a tinge of brown, except the pectoral and ventral, which are tinted with red; iris golden yellow. Young fish are of a yellowish white. This species is often called the carp-bream. An allied species of smaller size, the White Bream, or Bream-flat (Abramis blicca) is found in several of our rivers, as the Trent, Cam, and others, and is common in the lakes and rivers of the continent. It rarely exceeds ten or twelve inches in length, and is of a silvery bluish white, with silvery white irides. It is of little value for the table.

2423.—The Dace

(*Leuciscus vulgaris*). In the genus Leuciscus the dorsal and last fin below are short and destitute of spines; there are no barbules about the lips. The species termed collectively white-fish are numerous.

Fig. 2424 shows the Dace (La Vaudoise) in comparison with the Roach (Luciscus rutilus), la Rosse of the French. The lower figure is the Dace, the upper the Roach.

These two fish are common throughout the whole of Europe, and are abundant in our island; especially the roach, which is also more extensively spread on the continent. In many respects they are alike in their habits, and do not greatly differ from each other in appearance. "They be much of a kind," says Walton, "in matter of feeding, cunning, and goodness, and usually in size." The dace, however, is longer and not so broad as the roach, and its fins and eyes have a less brilliant colour, but they have both a handsome silvery appearance.

Roach prefer deep and quiet rivers, and will breed well in ponds; but dace love streams deep but clear, with a gentle current, and do not thrive so well in ponds. By day roach haunt deep water in and near beds of weeds, or under the shade of the trees which overhang the banks. Walton terms this fish the "water-sheep, for his simplicity or foolishness;" but several writers do not coincide with the venerated angler on this point. Roach fishing, indeed, is excellent practice for beginners; and almost as much quickness and dexterity are required as in fly-fishing. To the more experienced even the fish affords excellent sport: Walton added, "especially the great roaches about London, where I think there be the best roach anglers." Neither roach nor dace are in much estimation for the table. They both make good bait for pike, the dace for his silvery whiteness; and the roach, being more tenacious of life as well, is used for night-hooks. Roach are in the best condition in October, and dace in February, though on this point there are different opinions. Both spawn at the end of May, or early in June, and recover their strength in about a fortnight afterwards. Roach ascend the upper parts of the Thames preparatory to spawning; and vast shoals leave Loch Lomond at the same season, and during three or four days are caught on their migration in large numbers. The dace seldom exceeds nine or ten inches in length, but the roach attains a larger size. Mr. Jesse caught a Thames roach which weighed three pounds. Walton thought one of two pounds worthy of special notice. "The Thames," he says, "affords the largest and fullest in this nation, especially below London Bridge."

Mr. Yarrell observes that "Mr. Donovan, in his 'History of British Fishes,' says, 'In the River Thames, the finest roach are caught about the middle of May or early in June, when those fish come up in shoals from the sea to deposit their spawn in the higher parts of the river.' But the roach in this instance came from the direction only in which the sea lies, not I apprehend from the sea itself." The attempt to gain a higher station in the river, where the oxygen is in greater quantity at this season, accounts for the migratory movements of this and other fishes; but, adds Mr. Yarrell, "I have never known a roach to be taken in the sea into which the fish had entered voluntarily." Montagu, in his MS., referring to Donovan's statement of this migration from the sea, expresses his belief that Mr. Donovan was mistaken, and his conviction that the roach could not exist in sea water at all; quoting the following fact which came under his own observation. "In a small river that runs into a large piece of water, of nearly two miles in extent, close to the sea on the south coast of Devon, there is no outlet but by means of percolation through the shingle that forms a barrier between it and the sea: in this situation roach thrive and multiply beyond all example. About eight or nine years ago the sea broke its boundary and flowed copiously into the lake at every tide for a considerable time, by which every species of fish were destroyed." The following account of the alteration which has taken place with respect to the localities of roach and other fish in the river Thames appeared in the 'Penny Magazine' for 1842. It is a very interesting communication.

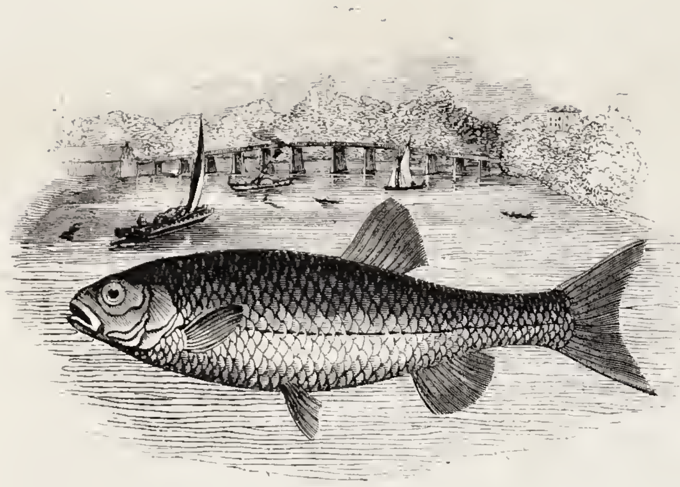
"Punt-fishing for roach by the starlings of Old London Bridge was once a common amusement of the city anglers, which they continued to enjoy to the end of the reign of George I. Sir John Hawkins, in his edition of Walton's 'Angler,' published in 1760, gives an interesting account of their latter-day exploits. 'The Thames,' he says, 'as well above as below bridge, was formerly much resorted to by London anglers; and, which is strange to think on, considering the unpleasantness of the station, they were used to fish near the starlings of the bridge. This will account for the many fishing-tackle shops that were formerly in Crooked Lane, which leads to the bridge.* In the memory of a person not long since living, a waterman that plied at Essex stairs, his name John Reeves, got a comfortable living by attending anglers with his boat: his method was to watch when the shoals of roach came down from the country, and when he had found them, to go round to his customers and give them notice. Sometimes they (the fish) settled opposite the Temple; at others at Blackfriars or Queenhithe; but most frequently about the chalk hills† near London Bridge. His hire was two shillings a tide. A certain number of persons who were accustomed thus to employ him, raised a sum sufficient to buy him a waterman's coat and silver badge, the impress whereof was 'Himself, with an angler in his boat,' and he had annually a new coat to the time of his death, which might be about the year 1730." In 1760 Shepperton and Hampton were much resorted to by London anglers for roach-fishing. If the respectable old angler who joyfully put his tackle in order when John Reeves announced a shoal of roach at London Bridge, could now see half a dozen steam-boats at one time moving between Queenhithe and Blackfriars (no unusual sight), he would easily conclude that his sport in that quarter was destroyed. But he would not at once perceive all the other causes which had driven the fish away, such as improved sewers disgorging the impurities of treble the population of the London of his day, the increase in a still larger proportion of manufactories, and the establishment of works he never dreamt of, for converting coal into a gas for lighting shops and streets. Turning to one of the Parliamentary Reports on the state of the water supplied to the inhabitants from the river, he would learn by the evidence of fishermen, that since 1820, flounders, eels, roach, smelts, salmon, and other fish, had been unable to live in that part of the Thames between Woolwich and Putney. In this Report, issued in 1828, Mr. Goldham, the clerk of Billingsgate-market, states that about twenty-five years ago there were four hundred fishermen, each of whom was the owner of a boat and employed a boy, and they obtained a good livelihood by the exercise of their craft between Deptford and London, taking roach, plaice, smelts, flounders, salmon, shad, eels, gudgeon, dace, dabs, &c. Mr. Goldham states that about 1810 he had known instances of as many as ten salmon and three thousand smelts being taken at one haul up the river towards Wandsworth, and fifty thousand smelts were brought daily to Billingsgate, and not fewer than three thousand Thames salmon in the season. Some of the boats earned 6*l.* a week, and salmon was sold at three shillings and four shillings the pound. The fishery was nearly destroyed at the time when this evidence was given. The masters of the Dutch eel-ships stated before the same committee that a few years before they could bring their live 'eels in "wells" as far as Gallions' Reach, below Woolwich: but now (1828) they were obliged to stop at Erith, and that they had sustained serious losses from the deleterious quality of the water, which killed the fish. Many other facts might be mentioned to the angler of the old school still more perplexing—of salmon brought from Scotland in ships moved by steam, and in such large quantities as frequently to sell at sixpence and eightpence the pound; of the supplies of fish from the coast being conveyed to London in three or four hours by railroads; and that by these means fresh fish, once the most difficult commodity to put into extensive circulation, was now regularly sold in the markets of most inland parts of the country not very many hours after being caught.

2425.—The Chub

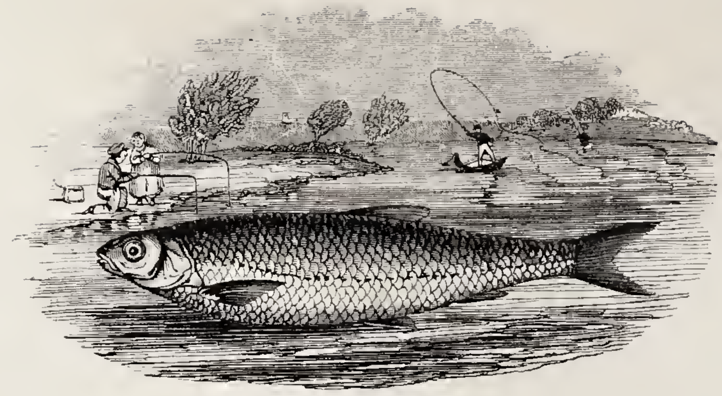
(*Leuciscus cephalus*). In most of our rivers in England, the chub is common. In some parts of the Thames it is very abundant, preferring deep spots under banks, sheltered by trees, and the tranquil water along the margin of willow-aits, where it shrouds itself from observation. It feeds on worms, insects, and their larvæ, and bites eagerly at the chafer-beetle, which forms the most killing bait. The chub seldom acquires a very large size, and specimens of even three and four pounds weight are very rare. The breeding season is from the end of April to the middle of May. The flesh of this species is of inferior quality. The general colouring above is bluish black, passing into bluish white on the sides, and silvery beneath. Top of the head blackish brown; pectoral fins reddish brown; caudal fin dusky; gills and iris golden yellow.

As species of the same genus we may enumerate the Ide (L. idus); the Dobule roach (L. Dobula); the Graining (L. Lancastriensis, Yarrell); the Red-

* Four persons of this craft still have shops in Crooked Lane.
† The depositions from the rubble composing the starlings.



2425.—Chub.



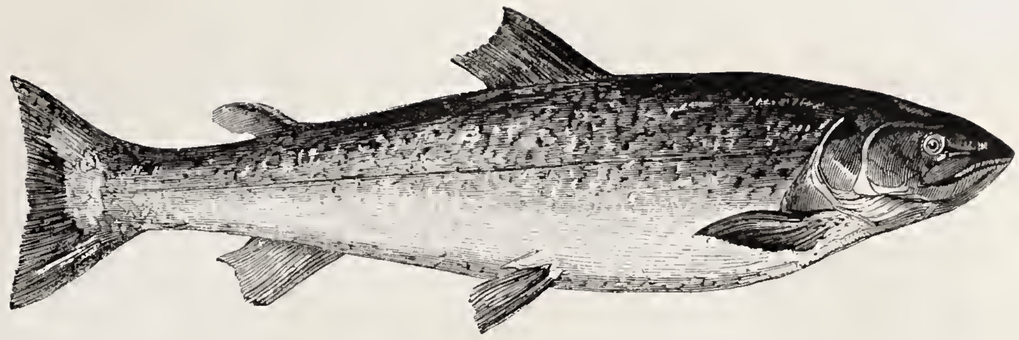
2423.—Dace.

2424.—Dace and Roach.

2426.—Netting Fishes.

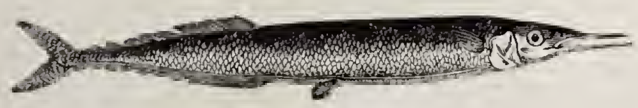
2427.—Otter hunting.

2431.—Group of Fish.

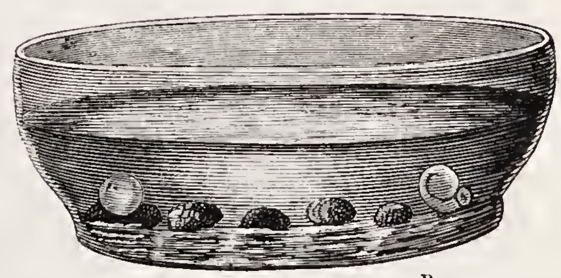


2433.—Salmon.

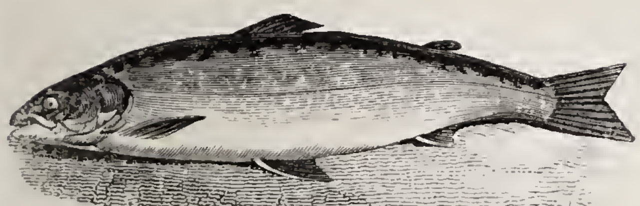
2428.—Pike.



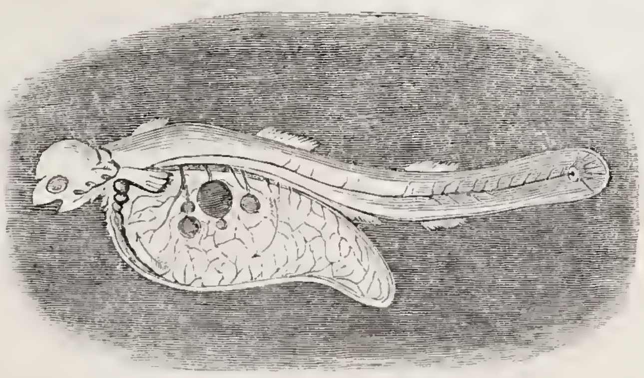
2429.—Garfish.



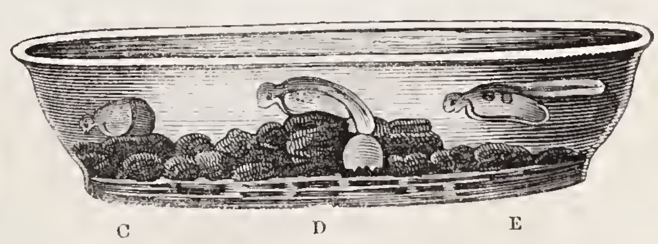
2434.



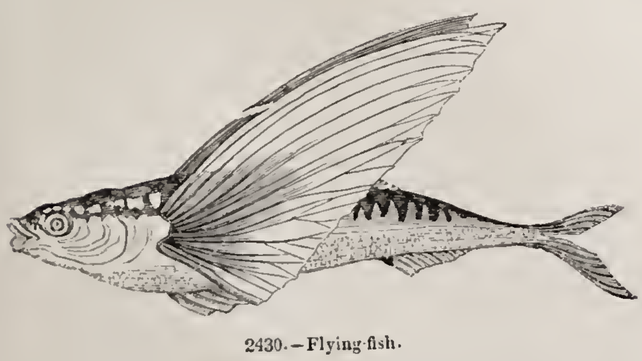
2432.—Salmon.



2437.—Young Salmon.



2435.



2430.—Flying-fish.

2434, 2435, 2436.—Progress of Spawn of Salmon.

eye or Rudd (L. erythropthalmus); the Azurine (L. cœruleus, Yarrell); the Bleak (L. alburnus); and the Minnow (L. phoxinus).

All these fish afford more or less sport to the honest angler, who "loves the sweet air of the sweet savour of flowers," and the "melodious harmony of fowls," and we may add those sylvan scenes, those quiet nooks, where the water now flows smoothly and slowly along, and now with quicker current "makes sweet music to the enamell'd meads," such scenes as our own rivers, winding their way "to the wide bosom of the ocean," present at every step—such as we see along the banks of the Avon (Fig. 2426), where the poet of nature once wandered, who in three lines describes the "contemplative man's recreation;"

> "The pleasantest angling is to see the fish
> Cut with her golden oars the silver stream
> And greedily devour the treacherous bait."

Nor must he forget the injunction of Dame Juliana Berners: "Ye shall use this foresaid crafty sport, for no covetyseness to the encreasing and sparing of your money only, but principally for your solace, and to the cause of the health of your body and specially of your soul."

Fig. 2427 represents a more animated scene, the Otter-hunt, the destruction of a beast noted for the ruthless havoc it makes among the finny tribes of our rivers and lakes, and accordingly hated by the angler: "The otter," says Izaak Walton, "devours much fish, and kills and spoils much more than he eats;" and well does he describe the bustle of the spirit-stirring hunt, "men and dogs, dogs and men, all busy!" to the catastrophe, when "the dogs have her, some above and some under the water," and she is "tired and past losing."

Family ESOCIDÆ (THE PIKES, GARFISH, &c.).

2428.—The Pike

(*Esox Lucius*). Jack, Luce, Pickerel; in Scotland, Gedd.

This voracious fish is common in the lakes and rivers of the greater portion of Europe; and though, as its rarity at one time proves, it is not an aboriginal of the waters of our island, there are few lakes, meres, or rivers in England, Scotland, and Ireland, in which it is not abundant. In the reign of Edward the First the value of the pike, as established by royal ordinance, exceeded that of fresh salmon, and was ten times greater than that of the best turbot or cod. In the time of Henry the Eighth so scarce was this fish, that a large one sold for double the price of a house-lamb in February, and a small one, or pickerel, for more than a fat capon. The pike is still in repute for the table, and in the north of Europe large quantities are taken and dried for winter consumption. Horsea Mere, and Heigham Sounds, two large sheets of water in Norfolk, covering a surface of six hundred acres, are celebrated for the quantity and excellent quality of the pike; and those of the Medway, as Mr. Yarrell observes, when feeding on the smelt, acquire excellent condition, with peculiarly fine flavour.

The pike grows rapidly, and in favourable localities attains to very large dimensions. In Horsea Mere pike have been caught weighing from twenty-eight to thirty-four pounds each; and Mr. Yarrell states that the result of four days pike-fishing at the above mere and Heigham Sounds, according to information which he received from a gentleman of celebrity in field-sports, was two hundred and fifty-six pike, weighing altogether one thousand one hundred and thirty-five pounds. Yet, as Izaak Walton correctly observes, "old or very great pike have in them more of state than goodness, the smaller or middle sized pikes being by the most and choicest palates observed to be the best meat."

The pike is certainly a very long-lived fish: Walton says Sir Francis Bacon "computes it to be not usually above forty years, and others think it to be not above ten years." But this is erroneous. Pennant refers to one ascertained to be ninety years of age, and Gesner, as Walton remarks, mentions a pike taken in Suabia, in the year 1497, at Hailbrun, on which was a brazen ring with these words in Greek, "I am the fish which was first of all put into this lake, by the hands of the Governor of the Universe, Frederick the Second, the 5th of October, 1230." The fish, therefore, was two hundred and sixty-seven years old. Mr. Yarrell states in addition that the skeleton, nineteen feet in length, was long preserved at Manheim as a great curiosity in natural history.

The voracity of the pike and the destruction which it makes among other fish are notorious. "Eight pike," says Mr. Jesse, "of about five pounds weight each, consumed nearly eight hundred gudgeons in three weeks; and the appetite of one of these pike was almost insatiable. One morning I threw to him five roach, each about four inches in length; he swallowed four of them, and kept the fifth in his mouth for about a quarter of an hour, when it also disappeared."

It is not only among fish that the pike makes havoc: frogs, water-rats, field-mice, also young ducks, dabchicks, moorhens, and other aquatic birds are seized and devoured, and instances are on record of other animals, and even man, being attacked. Gesner, says Izaak Walton, relates that a man "going to a pond, where it seems a pike had devoured all the fish, to water his mule, had a pike bite his mule by the lips, to which the pike hung so fast that the mule drew him out of the water; and by that accident the owner of the mule angled out the pike. And the same Gesner observes that a maid in Poland had a pike bite her by the foot, as she was washing clothes in a pond. And I have heard the like of a woman in Killingworth pond, not far from Coventry. But I have been assured by my friend Mr. Seagrave, that keeps tame otters, that he hath known a pike, in extreme hunger, fight with one of his otters for a carp that the otter had caught, and was bringing it out of the water."

Mr. Yarrell says, "The present head keeper of Richmond Park was once washing his hand over the side of a boat, in the great pond in that park, when a pike made a dart at it, and he had but just time to withdraw it. Dr. Plot narrates, that at Lord Gower's canal at Trentham, Staffordshire, a pike seized the head of a swan, as the bird was feeding, with the head and neck immersed in the water, and gorged so much of it as killed them both. The servants perceiving the swan with its head under water for a longer time than usual, took the boat and found both swan and pike dead."

At the breeding season, which occurs in March or early in April, the pike leaves the deep water, and seeks the weedy shallows and creeks, where its spawn is deposited. In the fens in the neighbourhood of Ely this fish is bred in great numbers: and in spring, shoals, as has been noticed by the Reverend Revett Sheppard, migrate thence into the river Cam.

We may here allude to one of the modes of catching pike, as practised on the meres of Norfolk, where the species abounds. It is by what is called a ligger or trimmer, which, says Mr. Yarrell, "is a long cylindrical float, made of wood or cork, or rushes tied together at each end; to the middle of this float a string is fixed, in length from eight to fifteen feet; this string is wound round the float except two or three feet, when the trimmer is to be put into the water, and slightly fixed by a notch in the wood or cork, or by putting it between the ends of the rushes. The bait is fixed on the hook, and the hook fastened to the end of the pendent string, and the whole then dropped into the water. When the bait is seized by a pike, the jerk looses the fastening, and the whole string unwinds, the wood, cork, or rushes, floating at the top, indicating what has occurred." The common modes of trolling need not be described.

The pike is admirably formed for velocity in the water; the body, the tail muscular, with the dorsal fin opposite the last under-fin; the head is long and depressed, with considerable breadth; the gape is extensive; the vomer is furnished with small sharp teeth, and there are numerous large teeth on the palatal bones, the largest being seated on the line of the inner edges. The superior maxillary bones have no teeth. The lower jaw exceeds the upper, and is armed anteriorly with numerous small teeth, while along the sides are five or six teeth, apart from each other, very long and sharp. On the top of the head are several mucous orifices placed in pairs.

In the lakes of North America a pike of huge size, called the Muskanungee, is abundant, and affords excellent sport.

2429.—The Garfish

(*Belone vulgaris*). Sea-pike, Mackerel-guide.

In the genus Belone the head and body are greatly elongated; the latter is covered by minute scales; the jaws are extremely long and slender, and taper to a point; they are armed with numerous small teeth; the dorsal fin is situated as in the Esocidæ generally.

The Garfish is abundant in the seas of Europe, and is found along the coasts of Norway and Sweden. In April or May shoals of this fish visit the shores of Kent and Sussex, for the purpose of depositing their spawn; and from their appearing a short time before the mackerel, has arisen one of the names appropriated to the species, viz., Mackerel-guide. During their stay, which is not of long continuance, numbers are taken for the London market; their flesh has some resemblance in flavour to that of the mackerel, but is more insipid, and their bones are green. Various parts of the Irish coast are visited by this fish; and, according to Mr. Couch, it is permanent on the Cornish coast, though most abundant in summer.

Great numbers are taken off the coast of Holland, but the garfish is there only used as a bait for more valued kinds.

As its form would lead us to predict, the garfish is quick and active in the water, swimming with considerable rapidity near the surface, and leaping and gambolling as if in the exuberance of vivacity.

The length of the upper jaw of this fish results from the elongation of the intermaxillary bones. The mouth is wide, and when opened both jaws simultaneously separate; the eye is large; the general colour above dark greenish blue, becoming lighter on the sides, and passing on the gill-covers and under parts to silvery white. Length about two feet.

2430.—The Flying-fish

(*Exocetus volitans*). This genus is at once distinguished among the Esocidæ by the extraordinary length of its pectoral fins.

The Flying-fish must be distinguished from the Flying Gurnard, which we have previously noticed, and which belongs to an entirely different section.

The flying-fish is met with in shoals in the warmer latitudes of the ocean, and has been seen also off different parts of our coast, although the exact species has not been determined.

Pursued by dorados and other fishes of prey, the flying-fishes endeavour to escape by rising out of the water, and skimming through the air, an action which they repeat successively, rising and descending, till out of sight in the distance. In the mean time their pursuers below keep up the chace, while gulls and albatrosses pounce upon them from above. "The greatest length of time," says Mr. G. Bennett ('Wanderings,' &c.), "that I have seen these volatile fish on the *fin*, has been thirty seconds by the watch, and their longest flight, mentioned by Captain Hall, has been two hundred yards, but he thinks that subsequent observation has extended the space. The most usual height of flight, as seen above the surface of the water, is from two to three feet, but I have known them come on board at a height of fourteen feet and upwards, and they have been well ascertained to come into the channels of a line-of-battle ship, which is considered as high as twenty feet and upwards. But it must not be supposed they have the power of elevating themselves into the air after having left their native element, for on watching them I have often seen them fall much below the elevation at which they first rose from the water, but never in any instance could I observe them raise themselves from the height to which they first sprang; for I regard the elevation they take to depend on the power of the first spring or leap they make on leaving their native element."

The food of these fishes appears to consist of mollusks and small fish; their flesh is accounted of excellent flavour, and is often eaten by mariners, at sea.

Fig. 2431 shows a Group of the Finny Race, amongst which the Flying-fish is conspicuous.

Family SALMONIDÆ (SALMON, CHAR, TROUT, &c.).

The Salmonidæ are characterized by their muscular contour, by the body being covered with scales, by the first dorsal fin consisting of soft rays, followed by a little fleshy fin formed simply by a fold of the skin filled with fat, and unsupported by rays.

2432, 2433.—The Salmon

(*Salmo Salar*). In the genus Salmo, the head is smooth; there are two dorsal fins, the second of which is fleshy without rays. There are teeth on the maxillary bones, the vomer and palatal bones, and a row of hooked teeth runs along each side of the tongue; branchiostegous rays ten or twelve.

The unrivalled excellence, among fishes, of the salmon, as an article of diet, its abundance, and its commercial importance, require no comments. A salmon fishery is valuable property; the rights and privileges connected with it, and the regulations to be observed in conducting it, have been settled by legislative enactments.

The salmon is a migratory fish, existing during one part of the year in fresh water, the other in the sea. It is a native of the former, and shoals of salmon annually work their way up the rivers of our island, of Ireland, and of the Northern portions of the continent, for the sake of depositing their spawn; in their progress, they surmount rapids and cataracts, still with unwearied perseverance pursuing their course, till they arrive at the suitable locality. In America, the salmon ascends the river St. Lawrence, and enters the tributary streams of Lake Ontario; but its progress within the United States is arrested by the Falls of the Niagara. Gesner, a naturalist of the early part of the sixteenth century, observed that "there was no better salmon than in England;" and Izaak Walton states, that "though some of our northern counties have as large and as fat as the river Thames, yet none of so excellent a

taste." Owing to the progress of population and the extension of manufactures, the salmon rivers in England are far less productive than formerly. A Thames salmon is now rarely seen,* and the rivers of the north of England, as well as those of the west, though they have not declined to the same extent as the Thames, or the Avon in Hampshire, are not now of much commercial importance. The case is different in Scotland, the principal supply of salmon being derived from the Tay, the Tweed, the Dee, the Don, and most of the streams along the eoast. The salmon rivers in Ireland are the Erne, the Moy, the Bann, the Blackwater, the Shannon, and nearly all the principal streams along the northern and western coasts.

As a general rule, it is in autumn that the salmon leaves the sea or mouth of the estuary, and pushes up the rivers and their tributary streams, whence they do not return till the spring, having in the interval deposited their eggs, which have become hatched (if the term be allowed), the young fry or smolts being carried down to the sea in the months of April and May: hence the proverb—

"The floods of May
Take the smolts away."

In some rivers, the salmon do not make their appearance until the middle of April or the beginning of May, as the Esk for instance, in Cumberland; and this delay is attributed to the lower temperature of the water, eompared with that of even adjacent streams. "Rivers," says Mr. Yarrell, "issuing from large lakes, afford early salmon, the waters having been purified by deposition in the lakes; on the other hand, rivers swollen by melting snows in the spring months, are later in their season of producing fish; and yield their supply when the lake rivers are beginning to fail."

"It has been suggested, that this variation in the season depended on the warmth of the waters, and that those highland rivers which rose from large lochs were all early, owing to the great mass and warmer temperature of their sources, and that the spawn there was sooner hatched. There are two rivers in Sutherlandshire, which show this late and early running under peculiar circumstances. One, the Oikel, borders the eounty, and springs from a small alpine lake, perhaps about half a mile in breadth; the other, the Shin, is a tributary to the Oikel, joins it about five miles from the mouth, but takes its rise from Loeh Shin, a large and deep extent of water, and conneeted by a chain of other deep lochs. Early in the spring, all the salmon entering the common mouth, diverge at the junction, turn up the Shin, and return as it were to their own and warmer stream, while very few keep the main conrse of the Oikel until a much later period." Artedi states, that in Sweden, the salmon spawn in the middle of summer.

Whether it be in the autumn or spring that the salmon aseends the river, it does not return to the sea till after the spawn is deposited; and the females are the first to ascend, the males coming after. The migration does not take place immediately on the fish leaving the sea, but they advance up the river or estuary, as far as the tideway is felt, ascending with each flood-tide, and descending with the ebb; and thus, remaining partly in salt and partly in fresh water, are better prepared for a long continuanee in the latter. Here stake-nets are placed for miles on both sides, and multitudes of fish captured.

The precise period at whieh the salmon enters the river does not appear to depend entirely upon the state of the ova, for while some fish proceed far up the river, the roe of others is in so mature a state that they can advance but half way, and others are compelled to seek out a suitable plaee in the shallows nearer its mouth. The great majority, however, as they get full of roe, aseend beyond the tideway, after a short continuance in the brackish water, and push on towards the sources of the stream, overcoming impediments whieh might be thought insurmountable. They will clear rapids or weirs which are eight or ten feet in height, and though at first baffled in their efforts, resume the attempt with surprising vigour. Sometimes they overshoot or mistake their mark and throw themselves upon dry land. Though they seldom spring out of the water more than ten feet, they have been known to deseend a fall of the height of thirty feet; and to leap over a dry rock of eonsiderable height and drop into the water on the other side. There is a fall (the fall of Kilmorac) on the Beauly, in Invernessshire, where, according to Mr. Mudie, in the 'British Naturalist,' the sight of a voluntarily cooked salmon has been witnessed. A kettle, it is said, was placed upon the flat roek on the south side of the fall, close by the edge of the water, and kept full and boiling until a salmon fell into the kettle and was cooked on the spot. This was one of the wonders which the Frasers of Lovat, who are lords of the manor, used to show their guests. This fall is said to be literally thronged with salmon endeavouring to pass higher up the river. It is an old opinion, and still very generally entertained, that previous to making a spring the fish curves its body and puts its tail in its mouth. Michael Drayton, in his 'Polyolbion,' alluding to a salmon-leap in the Tivy, has adopted this opinion :—

"Here, when the labouring fish does at the foot arrive,
And finds that by his strength he does but vainly strive;
His tail takes in his mouth, and bending like a bow
That 's to full compass drawn, aloft himself doth throw;
Then springing at his height, as doth a little wand,
That 's bended end to end, and started from man's hand,
Far off itself doth cast;—so does the salmon vault."

The faet, however, has been ascertained by observation, that salmon spring up nearly in a perpendicular line, and with a strong tremulous motion.

Having gained the upper and shallower part of the river, the fish seek out clear gravelly beds, where there is a strong current, and prepare to deposit their ova. They proceed, generally in the morning or during the twilight of evening, to make a furrow with their noses in the gravel, working against the stream, for the reception of the spawn. At this season, both males and females are unfit for food, and undergo a considerable alteration in appearance. The male becomes marked on the cheeks with orange-coloured stripes, and a golden orange tinge pervades the surface of the body, while the lower jaw elongates, and a cartilaginous projection turns up from the point, occupying, when the jaws are closed, a deep reeess between the intermaxillary bones of the upper jaw.

In this state the salmon is called a "red-fish." The females have acquired a dark colour, and are ealled "black-fish." It is unlawful to take either red-fish or black-fish, the prohibition being intended for the preservation of the race.

In making their furrow, we have said that the fish works against the stream; it eannot, in fact, work with the head down the stream, for the water forcing into the gills the wrong way drowns it.

The deposition of the spawn requires from eight to twelve days; and when this process is completed, and the ova covered up, the fishes betake themselves to the pools and deeper parts of the river to recruit. They are much out of condition, and are ealled "kippers" or "kelt-fish."

Experiments have been made at different times, relative to the vivification of the ova of the salmon, the most interesting of which are the two following: the first is detailed by Dr. Knox, in the 'Transactions of the Royal Society of Edinburgh.' On the 2nd of November, he observed the ova of a salmon deposited in the usual manner near the sources of the Tweed. On the 25th of February, or a hundred and sixteen days afterwards, the ova were dug up and found to be unchanged. On the 23rd of March, twenty weeks from the period of their deposition, the ova were changing, the fry lying in the gravel, after having cast the outer shell. On the first of April the fry had quitted the spawning-bed by ascending through the gravel. The ova may be hatched artificially by being put into bottles of water in warm rooms, but they cannot be preserved alive longer than ten days, during which they eat nothing. The other experiment was made by Mr. Hogarth, of Aberdeen, and is still more minute in its details than the former one; it is exemplified at Figs. 2434, 2435, 2436, and 2437, showing the progress of the spawn of salmon.

In the rivers and streams the ova become vivified during the months of March and April, according to the state of the season. By the end of May the water is full of the fry, from an inch in size, perfectly formed, to the size of a minnow. At first they keep in shallow water, but as their strength increases, they may be seen in the middle of the river or stream, moving towards the sea. The first flood or fresh which occurs at this period hurries them to the mouth of the river, where for a short time they remain in the tideway, and then proceed at once to the sea. In June, not a single "smolt" or "smoult," whieh is the name given to the fry, is to be found in the fresh water.

Referring to our pictorial illustrations, we may observe that at Fig. 2434, A shows the egg of the natural size after the vital prineiple has been developed. The body of the fish in this stage has a pinkish tinge, and the eyes are very large; B, the shell of the ovum just burst, and the head of the fish protruding from it.

Fig. 2435:—C, the state of the ovum eight hours after the bursting of the shell, when the pulsations of the heart become visible; D, the shell just thrown off, the tail drooping; about a third part of the shell, which is transparent, is fractured by the fish, in its exertions to extricate itself. Before the shell is broken, the tail envelopes the yolk, whieh is seen attached to the body of the fish; E, the tail, in a short time becomes straight, and the fish more lively; the mouth assumes a distinct form, and the lower and peetoral fins, which are quite transparent, are in motion simultaneously with the action of the heart, which beats from sixty to sixty-five times in a minute.

Fig. 2436:—F is a magnified representation of C, Fig. 2435, the fish adhering to the shell, which is partly broken. G represents E magnified: the heart is before the pectoral fins, under the throat.

Fig. 2437 is a still more enlarged view of E, showing the direction in which the blood circulates as seen by a microscope. The blood flows from under the body of the fish through the blood-vessels, ramified along the sides of the back, and is then collected into the large vessel which runs along the front and bottom of the bag, communicating directly with the heart. An equal quantity of air, or some transparent matter, circulates with the blood. The blood is drawn by the heart from the large vessel alluded to, and thrown in regular pulsations into the vessels of the head and throat, where it assumes a darker colour. The rays of the gills are visible, and the fish soon begins to assume a brownish eolour.

Salmon fry, or smolts, for some time wander about the sides of the stream, where the current is obstructed, but as they acquire strength, they trust themselves to the mid-stream, play in the pools and deep spots, and on the setting in of the spring rains, are earried down to the junction of the river with the salt water, where they remain till habituated to the novel element, into which they then proeeed. The growth of the smolts or young salmon is very rapid, espeeially after they have reached the sea, where food is in abundance. Fry marked in April or May, as Mr. Yarrell informs us, have returned by the end of June weighing from two to three pounds and upwards, and a month or two later they have been found to weigh as much as six pounds. The small sized fish under the weight of two pounds are called "salmon-peal," all above that weight "grilse." These fish hatched in the spring breed the first winter, and for that purpose return from the sea to the rivers rather earlier, as it would appear, than the adult fish, and though fewer ova are perfected, each egg individually is nearly as large as in the latter. The growth of the grilse during the second visit to the sea and for several subsequent years equals if it does not exceed that of the first year. The Sand-launce (Ammodytes Lancea) and other fishes constitute the food of the salmon when out at sea; and that it is a voracious feeder, may be inferred both from its rapid increase of size and its dental arrangement. Dr. Knox states that the food of the salmon eonsists principally of the eggs of various kinds of eehinodermata and some of the erustacea, and that to a certain extent the excellent flavour of its flesh depends on the riehness of its food. Salmon when in rivers rise at flies, like the trout, and have been taken with a minnow for a bait, and also with a worm. Mr. Yarrell quotes the following communication to himself from Sir W. Jardine, dated St. Boswell's, April 15, 1835. "The fisherman who rents this part of the Tweed fishing with worm one day last week had his hooks and taekle taken away by a fish; he put on a new set; and again with worm, in ten minutes hooked and killed a salmon with his former hooks and bait in his mouth. This will either prove extreme voracity, or little sensibility of the parts of the mouth. I have often heard fishermen mention a similar fact, but never before knew an instance on which I could depend."

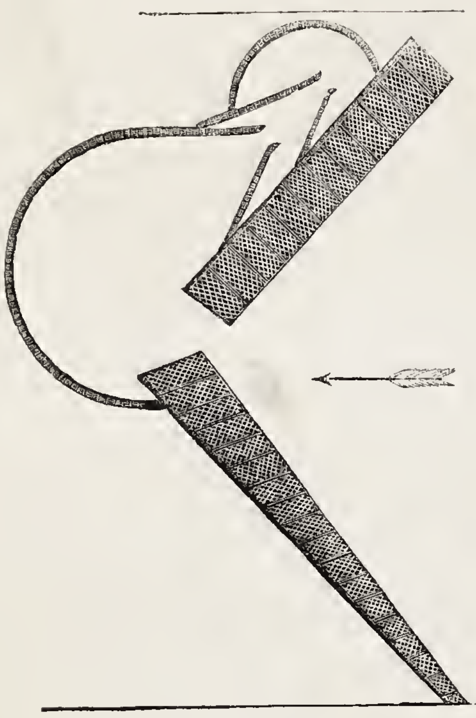
Though few salmon, perhaps none, that haunt our eoasts and visit our estuaries and rivers, ever attain to their full growth, or the eompletion of their natural term of existenee (so extensive and incessant is the destruction made amongst them), yet enormous speeimens have often been captured.

In 1835, Mr. Yarrell saw ten different fish varying from thirty-eight to forty pounds eaeh; and a notice of one that weighed fifty-five pounds appeared in the papers. Mr. Mudie has reeorded one of sixty pounds. Pennant mentions one of seventy-four pounds. Mr. Yarrell states that the largest salmon known, as far as he is aware, eame into the possession of Mr. Groves, the well-known fishmonger of Bond Street, in the season of 1821. It was a female, of eighty-three pounds, short for the weight, but of great depth and thickness; the flesh was fine in colour and of exeellent quality. Large salmon have oecasionally been taken by expert anglers, with a single line, and artifieial fly. Sir H. Davy captured one in the Tweed, above Yair-bridge, after a severe struggle; its weight was about forty-two pounds. In the Thames, at Shepperton Deeps, Mr. G. Marshall, of Brewer Street, London (October 3, 1812), caught and killed a salmon with a single gut, without a landing net, that weighed twenty-one pounds four ounees. (See Yarrell.) Mr. Laseelles ('Letters on Sporting') states that the largest salmon he ever knew taken with a fly was in Seotland: it weighed fifty-four pounds and a half.

Fig. 2438 represents the celebrated Coleraine Sal-

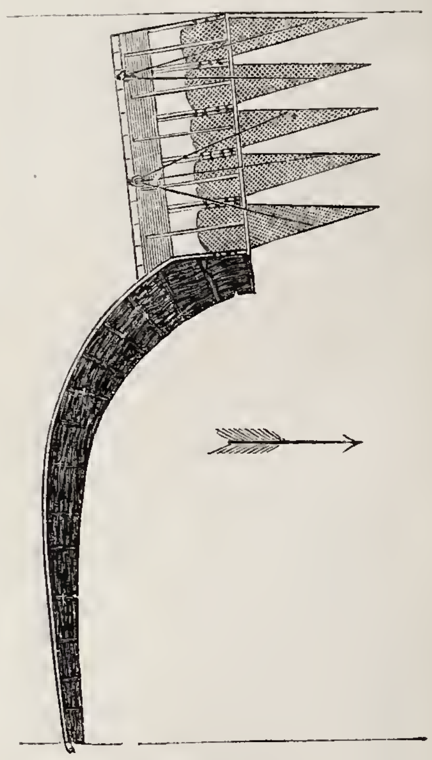
* Mr. Yarrell says, that the last Thames salmon of which he has a record, was taken in June, 1833.

2442.—Salmon-spearing by Torchlight.



2439.—Stake-Net.

2441.—Salmon-spearing.



2440.—Stage-Net.

2438.—Coleraine Salmon-leap on the Bann.

2444.—Chippeway Indian fishing on the Ice.

2443.—Chippeway Indians fishing.

2447.—Bidford Grange.

2446.—Trout.

mon-leap on the Bann, the resort of anglers. Angling for salmon is only resorted to as a recreation, and for taking fish for private consumption; other modes of wholesale capture are adopted for the supply of the markets. Of these one is by the stake-net (Fig. 2439). The stake-net was first brought into use on the Solway about a hundred years since, and was termed the raise or rise-net. Improvements were afterwards made in its construction, and gradually it became general; these nets were introduced on the Frith of Tay about the year 1797, and proved so advantageous, being efficient both during the flood and ebb tide, that double the number of salmon were taken than before they were in use. As many as five hundred salmon and grilses have been taken at one time in a stake-net. Stake-nets are only used where the tide is constantly ebbing and flowing, and are confined within the limits of low water mark, as they are not adapted to the middle of the channel. They are fixed by stakes driven into the rocky ground; and are visible at several miles' distance, serving to warn vessels off rocks and shallows, both by day and night, the noise made by the water rushing through them indicating their vicinity when they themselves cannot be distinctly seen.

Referring to Fig. 2439, we may observe that there are two lines of stakes at each end, hung with netting in order to obstruct the progress of the fish in their passage up the river; these are termed leaders, and are intended to conduct the fish into the inner court or chamber, within which at one end there are smaller chambers in which they are taken. The court opposed to the flow of the tide only takes fish passing up the river with the flood; but as salmon move backwards and forwards in the tide-way, some stake-nets are placed in a reverse direction to catch the fish moving down with the ebb. The spawned or unclean fish are not caught in the stake-nets, nor are the fry, owing to their keeping in the middle of the stream; while the clean fish, in a state of vigour, roam at large both through the deep and shallow water. We may add that the narrow line of stakes begins on the shore at high water mark; it gradually increases according to the increase of depth, the deep line of stakes being at low water mark.

Fig. 2440 represents the stage-net, which has been greatly superseded by the stake-net; it is adapted for the coast or tideway of a river, and is, like the latter, stretched between high and low water mark. The leader, which terminates at high water mark, is formed of stakes, and rough wicker-work; the fishermen are stationed on a platform or stage above the bag-nets, and see or feel when a fish enters one of them, when it is immediately drawn up to the top of the stage and the fish taken out and killed. We may enumerate cobble-nets, used in the higher parts of the river, and in pools, above the tidal rise; but as the nets are trailed over the top of the spawning beds, raking them up, this mode is justly regarded as injurious. Cruives are formed by artificial dikes, which act as leaders, conducting the fish into a trap, or receptacle in the dam wall, through which the water rushes, and in which grating of a peculiar structure prevents the exit of the fish.

Fig. 2441 represents a mode of spearing salmon as practised in some parts of Scotland: it is often termed stream-fishing. A dike of loose stones is constructed in the river, which acts as a leader to the fish coming up the stream, directing them to the channel nearest the bank; at the end of the dike there is a hut in which the fisherman waits the approach of the salmon, which he strikes with a five-pronged instrument.

Fig. 2442 represents salmon-spearing by torch-light. This is an animated mode requiring great skill and dexterity. In the long pools of deep clear water, nets are placed in various directions: the disturbance of the water by the boats, and the glare of the lights, terrify the fish, which rush into the nets, while those passing within reach are speared and killed. A somewhat varied method is graphically described by Sir Walter Scott, in 'Guy Mannering,' and which may, as he says, be called a kind of salmon-hunting. The account is as follows:—"The chace, in which the fish is pursued and struck with barbed spears, or a sort of long-shafted trident, called a waster, is much practised at the mouth of the Esk, and in the other salmon rivers of Scotland. The sport is followed by day and night, but most commonly in the latter, when the fish are discovered by means of torches or fire-grates filled with blazing fragments of tar-barrels, which shed a strong, though partial, light upon the water. Upon the present occasion, the principal party were embarked in a crazy boat, upon a part of the river which was enlarged and deepened by the restraint of a mill-weir, while others, like the ancient Bacchanals in their gambols, ran along the banks, brandishing their torches and spears, and pursuing the salmon; some of which endeavoured to escape up the stream, while others, shrouding themselves under roots of trees, fragments of stones, and large rocks, attempted to conceal themselves from the researches of the fishermen. These the party in the boat detected by the slightest indications; the twinkling of a fin, the rising of an air-well, was sufficient to point out to these adroit sportsmen in what direction to use their weapons." A hundred salmon were often taken during one of these animated excursions, and, it is added, that "the best were selected for the use of the principal farmers; the others divided among their shepherds, cottars, dependants, and others of inferior rank who attended. These fish, dried in the turf-smoke of their cabins or shealings, formed a savoury addition to the mess of potatoes, mixed with onions, which were the principal part of their winter food." Spearing salmon by torch-light is sometimes practised near the mouth of a river, or in one of the lochs, when the scene is peculiarly striking, resembling those which take place in the north of Europe.

Fig. 2443 represents the mode of spearing fish by the Chippeway Indians on the River Thames, which rises in the country between Lakes Ontario and Huron, and falls into Lake St. Clair. This manner of fishing "requires a dexterity in its management which scarcely any but an Indian can achieve. Two Indians occupy a canoe in the centre of the stream: one poises himself on each edge of the vessel in front, the other in a similar way behind: each has a fish-spear. The canoe, though probably in the centre of a rapid stream, amid rocks, and shoals, and eddies, is kept perfectly steady, and in a straight course, by occasional thrusts and shoves at any object which presents itself,—an overhanging or sunken rock, or the broken trunk of a fallen tree. The labour of keeping the boat steady does not interfere with the spearing of the fish, which is carried on in silence, and with unceasing attention. The fish, as caught, are jerked off the spear into the boat; they are afterwards handed over to the women, who clean them, and dry them by suspending them from a stick over a smoky fire. This mode of catching fish never fails to attract the attention of Europeans, from the dexterity with which it is done, and the seeming danger of the operation. The Indians resort to the streams and rapids in spring and autumn, as the fish are then running—attempting the passes in shoals."

Fig. 2444 represents the mode of fishing on the ice, as practised by the Chippeway Indians. The scene is Lake Huron, with the lighthouse on the shore in the distance. The fisher or spearman is what is termed a British Indian—one of those located near British settlements, and who are under the protection of our government, receiving yearly allowances in manufactured articles and food, in return for having sold their lands. He is represented in the usual costume worn by these Indians, and engaged in fishing in the ice. During winter, when their supplies of dried flesh and fish are exhausted, they resort to this uncomfortable and cold mode of obtaining food. A hole is broken in the ice with a hatchet; a piece of wood carved into the shape of a fish, and coloured, to resemble one, having tin fins and tail, and balanced by a piece of lead in the belly, is suspended in the water by a string of gut from a short stick which is held in the left hand. This deception attracts the fish to the spot, when they are struck by the spear held in the right hand, and brought up. When cold frosty winds prevail, the Indians frequently erect a temporary hut of poles and blankets over the hole which they have made in the ice, with an opening in the top to admit the light; this not only protects them in some measure from the effects of the cold, but also enables them to see the fish more easily, as the rays of the sun on the snow dazzle and injure the eyes. This kind of hut is represented in the engraving. In the distance is a lighthouse on the shores of Lake Huron, and to the left are the rapids of the St. Clair, unfrozen, with Fort Gratia, belonging to the United States. Fort Gratia is situated at the mouth of the St. Clair, where it issues from Lake Huron.

The lakes and rivers of North America yield an abundance of excellent fish, as well as aquatic wild-fowl. The only lake in the great chain of lakes which yields such fish as make migratory excursions to the sea, salmon, &c., is Lake Ontario—the falls of Niagara presenting an effectual barrier to their visiting the other lakes. But the fresh-water stock of fish in these lakes is sufficiently diversified; amongst the favourite sorts are white-fish, particularly those of the Detroit river, the grey or salmon-trout, black and rock bass (there are also white and striped bass), pickerel, pike, and fresh-water herrings. Some of the outlets of the lake abound with sturgeon, but in general the flesh of the American sturgeon is but little esteemed. A species of pike, called the Muskanungee, grows to a large size, and is considered by many an excellent fish. In the very small lakes of North America the grey or salmon-trout is never found to exceed four or five pounds in weight; in the larger lakes it is to be found of ten or twelve pounds; but in the "great lakes" it will sometimes be found of the weight of thirty or forty pounds. All the rivers and small streams are stocked with trout of delicious flavour.

2446.—The Trout

(*Salmo fario*). This excellent fish is spread over the continent, and is common in the British Islands. It delights in clear and sparkling rivers, which have a rapid current, bubbling over stones, and tumbling down weirs and little falls, where the picturesque watermill well accords with the attractive scenery (see Fig. 2447.) In such rivers trout lurk in the deep pools, in the shadow of large stones, or under the precipitous banks during the day, bestirring themselves towards evening, when they eagerly pursue their prey. The trout is abundant also in our stream-fed lakes, and those of Scotland and Ireland. The great difference in size and colour which this fish displays in different localities is very remarkable, and has led to the suspicion that it was connected with distinction of species; but when we take into account the variety in the character of the water, and the influence which the soil and the several strata over which it passes in its course have in producing modifications in its quality, connected with the nature and respective abundance of food which different rivers afford, according to the soil and general aspect of the country through which they pass, we may perhaps account for the difference of size and colour exhibited. Still it is by no means impossible that distinctions of species as well as of mere variety may be ascertained.

In the Wye, the Dove, and Derwent (Derbyshire), the trout are numerous but small, measuring from six to ten inches in length on the average; and in some inky streams that flow over shale in the hills near Buxton, and are impregnated with iron, we have seen numerous trout of small size and so dark, that, by way of distinction, they might be called black, while those in the Wye at Bakewell, and in the Derwent and Dove, are brightly coloured. Black trout occur in Loch Knitching and also in Loch Katrine, the colour being attributed to the drainage from the boggy moors.

There are fine trout-streams in Hampshire, Surrey, Wiltshire, and other counties, and splendid trout are caught in the Thames above Hampton; we have seen trout from the latter locality from nine to eleven pounds weight, but larger have been taken, some of the weight of fifteen pounds. These noble fish are generally caught by trolling or spinning with bleak, gudgeon, or minnows, but they will rise at the May-fly. To land one of these trout requires no ordinary skill and patience. There are some deep pools in the Thames above Oxford where fine trout are to be captured—Mr. Yarrell records six taken by minnow-spinning, which weighed together fifty-four pounds, averaging nine pounds each.

In March, 1835, a male Thames trout, as stated by Mr. Yarrell, of the weight of fifteen pounds, was taken in a net; its length was thirty inches. In the April of the same year, a male trout of eleven pounds weight was caught in the same manner; its length was twenty-eight inches. "A few years since a notice was sent to the Linnean Society of a trout that was caught on the 11th of January, 1822, in a little stream ten feet wide branching from the Avon, at the back of Castle-street, Salisbury: on being taken out of the water its weight was found to be twenty-five pounds."

Various kinds of flies, as May-flies, stone-flies, &c., the ova of other fishes, the aquatic larvæ of insects, and small fishes, constitute the food of the trout. From experiments which have been made by feeding trout, placed in separate tanks, respectively on worms, minnows, and dark coloured water-flies, it was found that those fed with worms grew slowly and had an emaciated aspect; those nourished with minnows, on which they darted with voracity, became much larger; while those to which flies only were given attained in a short time prodigious dimensions, though the quantity of food swallowed by them was nowise so great.

The breeding season of the trout is generally in October, at which period the adult fish ascend the river and deposit their spawn in the same manner as the salmon; the under jaw of the male becomes also elongated and curved upwards. In May the trout comes into full season, and then acquires the brightest tints and deepest spots, the flesh also being of a livelier pink and superior flavour. This condition of the fish continues during the summer, depending, however, on the quantity and quality of the food, hence in some rivers the fish becomes out of season sooner than in others.

In its habits the trout is shy and wary, and the angler's success will depend much on the wind, the sky, the choice of the fly, and his knowledge of the river in which he angles. On these points, how-

ever, we must refer to works which professedly treat on the subject of angling.

We may here observe that in Lough Neagh, and other loughs in Ireland, a variety of the trout, called the Gillaroo, which attains to a considerable size, is found. The internal surface of the stomach of one examined by Mr. Yarrell presented an indurated cuticle, but the parietes were not thicker than those of other trouts: the teeth are small, but in number and situation like those of the ordinary kind.

Deformed trout with the upper jaw truncated, or stunted in growth, and the lower jaw protruding, occur in some of the lakes in Wales, and have been taken also in a small loch called Lochdow near Pitmain in Inverness-shire. They are of small size: a specimen from Lochdow is in the Museum of the Zool. Soc.

The trout is too well known to need a minute detail of form and colouring.

2448.—THE NORTHERN CHAR, OR CHARR

(*Salmo umbla*, Linn.). Salmo Alpinus, Pennant; Ombre Chevalier of the Lake of Geneva.

When Walton published his 'Angler' he stated his belief that the char was only to be found as a British fish in Lake Windermere. This, however, is not correct: it inhabits many of the Lakes of Cumberland, Westmoreland, and Lancashire, as Keswick, Crummock Water, Buttermere, Coniston, &c.; it is also found in many of the lochs of Scotland, as well as of Ireland, as Loughs Esk, Egesh, Neagh, Dan, &c. The lakes of the Tyrol are famous for char. Speaking of this fish, Sir H. Davy says:—"They generally haunt deep cool lakes, and are seldom found at the surface till late in the autumn." At this period they will take either fly or minnow, and he mentions, as something remarkable, having caught a char in summer in one of the beautiful small deep lakes of the upper Tyrol, but it was where a cool stream entered from the mountain, and the fish did not rise but swallowed the artificial fly under water.

Char afford the angler but little sport; yet the fly-fisher whipping for trout, which often abound in the same lakes, occasionally hooks one of the former, but it is by no means a common occurrence.

Except at the spawning season, November and December, the char never leaves the deep clear water of the lake; at that period, however, they make their way up the rivers, preferring those with a rocky channel: as an instance in point, Mr. Yarrell remarks that of the two principal feeders of Windermere (viz. the Rothay and Brathay), the Rothay has a sandy bottom, but the channel of the Brathay is rocky. Before merging into the lake, these streams unite, at the western corner of the head of the lake, and the shoals of char entering to spawn, push their way up both of these rivers, but those fish which have ascended the sandy-bedded Rothay (a river to which the trout gives the preference), finding it unsuitable, invariably return, and pass up the rocky channel of the Brathay, where they deposit their eggs.

Fig. 2449 represents a view of Lake Windermere, celebrated for the beauty of the surrounding scenery, and the excellence of its finny tenants.

From some cause or other, the char, even at the same season of the year, exhibit great differences in their tints, and the intensity of their colour. Hence the terms Case Char, Gilt Char, Red Char, and Silver Char, which have been applied to the different varieties. Food, age, or individual vigour may in some measure perhaps modify the tints; but after all the explanation is not very easy. According to M. Jurine, in the Lake of Geneva the females are the finest in colour, but Mr. Mascall (in 'Mag. Nat. Hist.' April, 1835), states that, in the Lake Ennerdale, Cumberland, he found the males of the richest hue.

The char is not a large fish; it seldom exceeds twelve or fourteen inches in length, though some occasionally attain to eighteen inches, and even two feet. As a delicacy for the table, it is undoubtedly one of the first of fresh-water fish, combining the flavour of the trout with that of the mullet. From a correspondent to the 'Penny Magazine,' (April 25, 1840,) experienced in char-fishing, and a lover of the beauties of scenery, no less than of the angle, we quote the following:—

"On account of these interesting and valuable fish, some sections of both Windermere and Coniston Lakes rent pretty high as fisheries; and although they do not yield any great quantities, the price these fish command in the market commonly remunerates, in a moderate degree, the persons employed in the fisheries. The common size of the Windermere char certainly does not, on the average, equal half a pound each: some few are caught that weigh a pound, or something more; but, probably, six ounces would be nearer the average weight of those that are annually taken. On account of their small size, it will at once appear obvious that they are not well adapted for being dressed and brought to table, in the ordinary way, that is boiled,—neither are they commonly broiled or dressed as a pan fish, and, when they are so, they are scarcely, if at all, superior to good trout. They possess a flavour, however, that connoisseurs seem greatly to admire; and the flesh when dressed has a rich and inviting appearance, being beautifully flaky, and of a deep orange tinge. But the general way of dressing these fish is that of potting—that is, seasoning them with certain condiments after they have been stewed and the bones taken out, and afterwards placing them in courses in shallow pots (hence potting), of seven, eight, or nine inches in diameter, and pouring the finest melted fresh butter over the fish until they are well covered, and thus secured from the action of the air. They are so highly seasoned, that with this simple covering of butter, the pots containing the char may be sent to any part of the kingdom, and the fish will remain untainted for some months. This enables the persons connected with the char fisheries to send them to the best markets, our luxurious metropolis being undoubtedly at the head of the list. They are usually sold in half-guinea and guinea pots.

"Disavowing all malice or ill-will towards the char-potters of Bowness, Ambleside, Coniston, and others in the vicinity of those lakes where this profitable business is carried on, I cannot abstain from stating that which I know to be an undeniable fact, namely, that in many cases a smaller quantity of char is mixed with a larger quantity of trout, or some other inferior fish, and the adulterated pots then sold as genuine char. This is only, it is urged, a common trick with most manufacturers, and not considered any serious imposition to substitute a few nice plump trout in the place of as many char. An acquaintance of mine, who resided on the banks of Windermere, and who possessed opportunities of ascertaining the produce of the fisheries in real char, as well as the quantities exported from thence, in pots alone, amused himself with making calculations, and the result was, that he found nearly three times the quantity exported that were actually caught.

"Except in the spawning season, the common haunts of these fish are in the clear and deep water; and the usual way of taking them is in sunken nets, or trammels, as they are called, which are furnished with bait to allure the fish; and which sometimes remain set for several days before any of them are enticed into the snare. Their haunts are generally badly calculated for employing drag nets, on account of the rocky nature of those lakes. It has already been stated that these fish do not afford the angler much amusement; nevertheless they are now angled for far more than they formerly were. An expert angler, however, may think himself fortunate if he succeed in killing more than a dozen during the day. They are occasionally allured to the surface by a tempting artificial fly; but trolling with a small minnow several feet below the surface is a more likely mode of not being forced to leave the fishing-ground with an entirely empty fishing-basket."

"In its shape this fish approaches that perfect symmetry for which many of the Salmo species are so very remarkable; not differing materially from the common trout, though, perhaps, a little more slender and tapering than a trout that is plump and well fed. The colour of the red char—for there is another variety called case char, and the fishermen would make out a third, which they call gilt char—may be described as follows: The head terminates in rather a blunt point, the under jaw scarcely at all projecting. The pupil of the eye is black, in a silver iris, surrounded with a circle of gold. The body is covered with very minute scales. The dorsal fin, which is yellow, is marked with a few dark spots; the back is dark with a peculiarly beautiful greenish cast, shading into the most delicate white on the lower parts, and tinted with a bluish-like hue that is difficult to describe. All the fins, except the dorsal, are reddish; and during the season of spawning, the belly for the most part becomes as red as the fins. The body all over is sprinkled with pale spots, of a considerable size for so small a fish."

The Welsh Char, or Torgoch (red-belly), found in Lyn Cawellyn, and a piece of water near Barmouth in Merionethshire, called "Coss-y-gedawl," is a distinct species; it is a deeper and shorter fish with a larger eye and teeth and more ample fins than the Windermere species. It is described and figured by Donovan, and also by Mr. Yarrell under the title of Salmo savelinus.

2450.—THE GREAT GREY TROUT

(*Salmo ferox*). Lake Trout, Salmo lacustris, Berkenhout.

This noble species, which according to Mr. Agassiz differs from any of the large Continental species, is a native of many of the larger and deeper lakes of Scotland and Ireland. It occurs in Loch Awe, Loch Laggan, Lochs Shin, Loyal, and Assynt, in Lough Neagh, in Ireland, where it is called Buddagh, and in Ullswater Lake in Cumberland. Dr. Heysham records it in his catalogue of Cumberland animals, and observes that some specimens have been found to weigh between fifty and sixty pounds.

It is probably the trout mentioned by the Rev. Mr. Lowe, in his 'Fauna Orcadensis,' as occurring in the Orkneys and Shetlands, and weighing thirty-six pounds and upwards. We have seen specimens from Lough Neagh thirty-five inches long; they were exhibited at the Zool. Soc. June 9, 1835, by Mr. Thompson, and are alluded to by Mr. Yarrell.

This species roves about indiscriminately, and feeds almost entirely upon the smaller fish. By persons residing on the banks of the lakes which they inhabit, numbers are often taken by night-lines, "few rising at the artificial fly, but they may be always taken by strong trolling tackle baited with a small trout; they are extremely voracious, and having seized the bait, will allow themselves to be dragged by the teeth for forty or fifty yards, and when accidentally freed, will immediately again seize it." Young fish will rise freely at the fly. This species seldom ventures either up or down any of the streams connected with the lakes; it spawns in September.

2451.—THE SMELT

(*Osmerus esperlanus*). Sparling and Spirling, Provincial.

In the genus Osmerus, the body is elongated and covered with small scales; there are two dorsal fins; the first with rays, the second fleshy without rays. The ventral fins are placed in a vertical line under the common cement of the dorsal fin; teeth on the jaws, and tongue long and sharp; two distinct rows on each palatal bone, none on the vomer. Branchiostegous rays eight.

The true smelt seems to be confined as a British fish to the eastern and western coasts of our island; its place along the southern coast being occupied by the Atherine, or Sand-smelt (Atherina Presbyter, Cuv.), which is very plentiful, of excellent quality, and with a slight odour of cucumbers; it is one of the Mugilidæ (Acanthopterygii).

Like the salmon, the smelt visits the rivers, which it inhabits from August to May; it spawns in March or April, after which the shoals return to the sea. In the month of August, the young fry may be seen in the mouths of rivers, swimming near the surface, ascending and descending with the tide; at this period the adults are making their way up the river. Formerly these fish abounded at the proper season in the Thames from Wandsworth to Hammersmith, but at present, owing to the state of the water, none advance so high as London. The Medway produces smelts of excellent quality. The peculiar odour of this fish, resembling that of a cucumber, is well known; it is very powerful when the fish is just taken from the water, but a few days' exposure to the air greatly diminishes or even destroys it, and the delicate flavour of the flesh is lost. During the present season, 1844, smelts have been very abundant in the London market.

Experiments seem to prove that the smelt will not only live, but thrive and multiply in the fresh water of ponds or lakes. Colonel Meynel, of Yarm in Yorkshire, introduced smelts into a fresh-water pond of about three acres, having no communication with the sea; here they remained for four years, and greatly multiplied; they were not affected by the freezing over of the pond, though the ice was sufficiently strong to admit of skating; and when at last the pond was drawn, they proved to be equal in size and flavour to the finest which had enjoyed their natural range.

The smelt is a voracious little fish; it devours young fry, and small crustacea, as shrimps and mollusks. In the Thames and Medway this fish is taken by means of small meshed nets, from the 28th of August till Good-Friday. Along the eastern coast, and especially Lincolnshire, numbers are taken in shallow bays. They occur in the Swale in Essex.

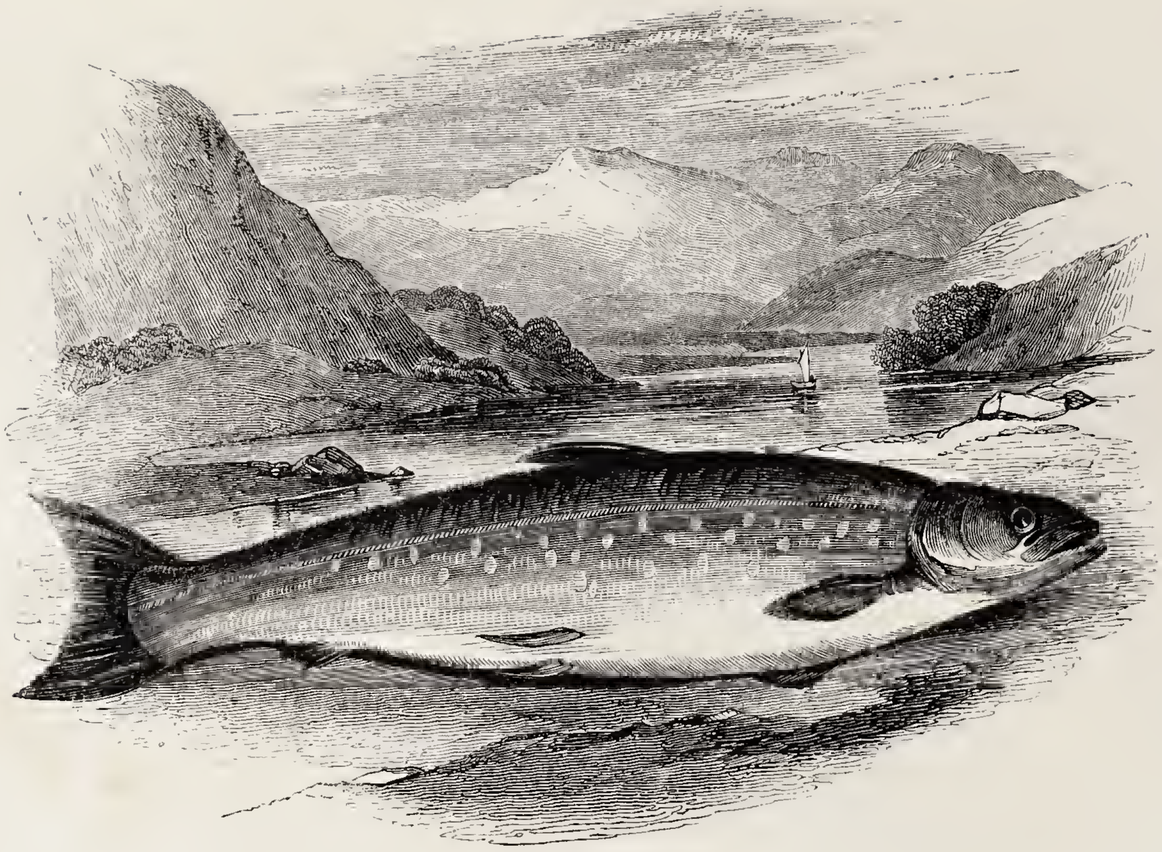
The smelt as seen in the shops is seldom above six or seven inches in length; occasionally specimens of ten or eleven inches occur; and Pennant mentions one which measured thirteen inches long, and weighed eight ounces.

The back of the smelt is of a pale greyish green passing on the sides into silvery white, which is the colour of the gill-covers and under parts.

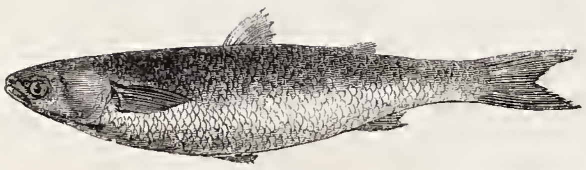
Figs. 2452 to 2460:—Various species of caddis worms, the larvæ, Phryganeæ, enclosed in cases, some composed of leaves, some of little pebbles and shells, some of straws, some of grains of sand agglutinated together. These caddis worms are the favourite food of many of the freshwater fishes, and are killing baits.

Before concluding our outline of the Salmonidæ, we may observe, that as respects the genus Salmo, great difficulty exists in discriminating between many of the species, especially when young.

The Parr or Samlet has been and still is in some places regarded as the young of the salmon. Mr. Yarrell says, "The fry of the different species of



2448.—Northern Char.



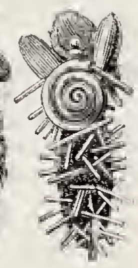
2451.—Smelt.

2452.

2453.

2454.

2455.



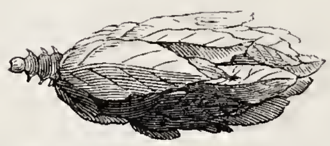
2456.

2450.—Great Grey Trout.

2457.

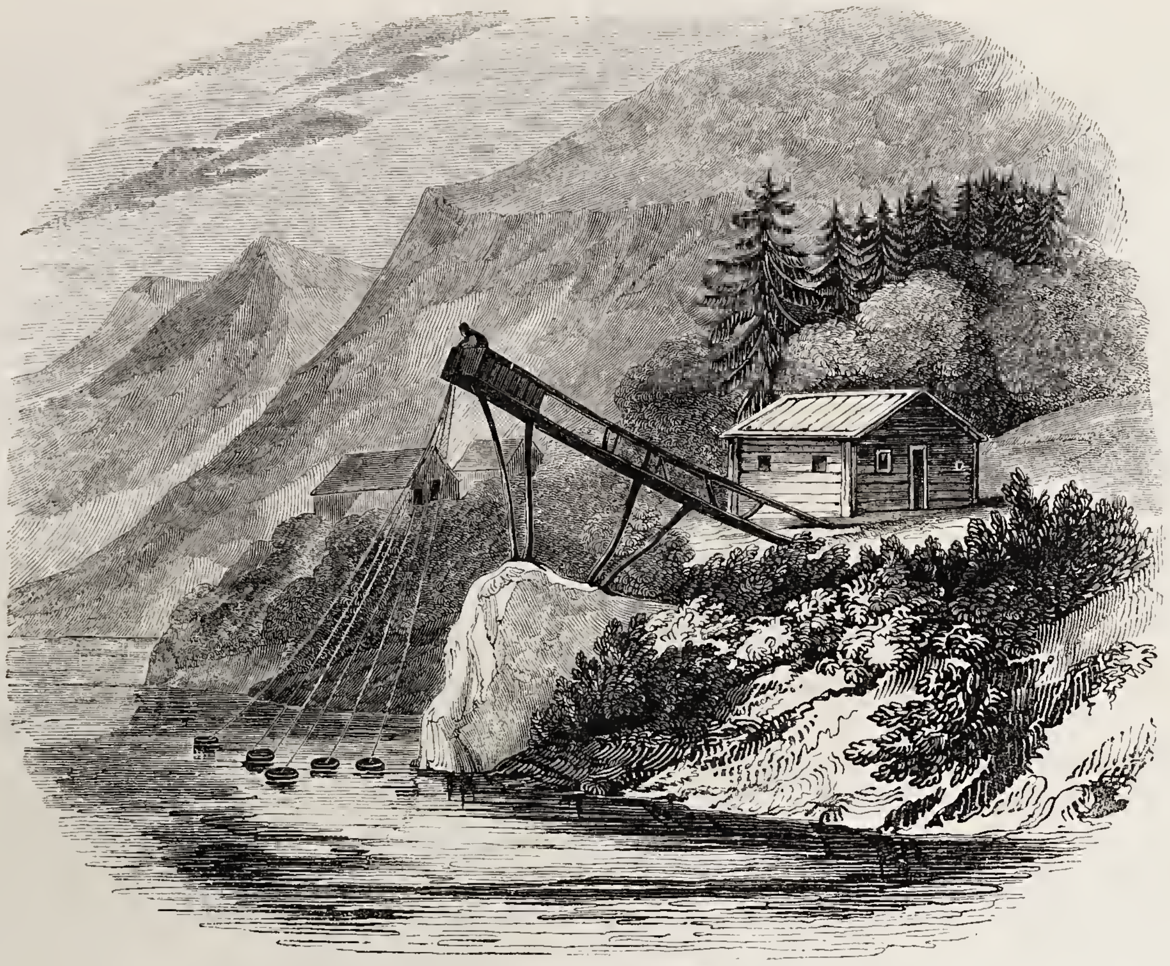
2459.

2460.

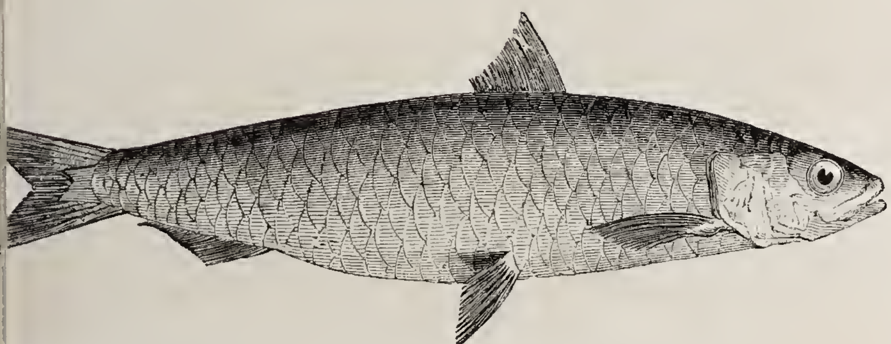


2458.

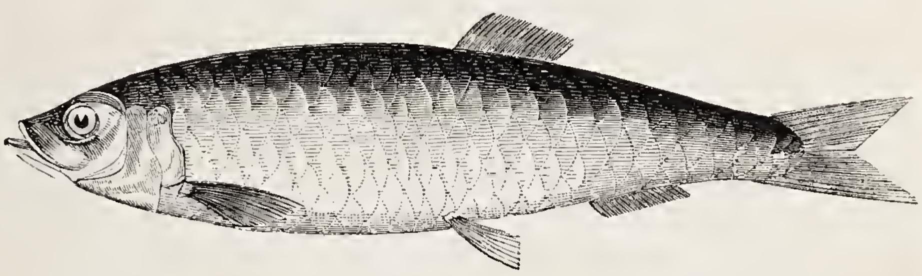
2449.—Lake Windermere.



2461.—Salmon-fishing, on Lake Söstrand, Norway.



2463.—Pilchard.



2465.—Herring.

2464.—Pilchard-fishing in Mount's Bay, Cornwall.

migratory Salmonidæ are even now probably accurately known only to a few persons; their great similarity, when very small, has so frequently deceived even those who have lived the greater part of their lives on the Salmon river banks, that the fry marked by them in their experiments, have been retaken as Grilse, Bull-trout, Salmon-trout, and river-trout."

The species of the genus Salmo, described as British by Mr. Yarrell, are—the Salmon (S. salar), the Bull-Trout (S. eriox), the Salmon-Trout (S. trutta), the Parr or Samlet (S. salmulus), the Common Trout (S. fario), the Great Grey Trout (S. ferox), the Northern Charr (S. umbla), and the Welsh Charr (S. savelinus). The other Salmonidæ are the Smelt (Osmerus esperlanus), the Grayling (Thymallus vulgaris), the Gwyniad (Coregonus fera?), the Vendace (Coregonus, Willughbii), and the Argentine (Scopelus, Humboldtii).

Fig. 2461 represents a Salmon Fishery on the Söstrand fiord (or loch), in Norway.

The Norwegian salmon, which are large and of excellent quality, are caught in various ways. One of their methods deserves a description, and seems to be very effective. In descending one of the longest and most picturesque of the fiords (Söstrand fiord), Mr. Twining's attention was caught by a number of small barrels floating on the surface of the water. "These barrels," he says, "at a short distance from each other, were secured each by a thin rope or cord, and all these cords were joined together at the end of a high scaffold that projected over the fiord: it was a sort of platform, long and narrow, one end of which rested on the bank, while the other, at a slight angle of elevation, was supported by long poles on the edge of a rock that advanced into the water. It was not long before I saw the head and arm of a man, whose body was concealed behind a sort of screen, made of planks, at the end of the platform. Although he did not make the least motion, he appeared very much occupied, and was evidently not perched on that frail observatory for motives of mere curiosity. My boatman explained the enigma by telling me that he was fishing for salmon. A large net is suspended horizontally under the barrels, and the extreme transparency of the water of the fiord permits the fisherman to see all the fish that swim in it. When a shoal of salmon passes over his net, he rapidly draws up in one clue all the cords attached to the different barrels; the barrels thus close together at one point,—the net is shut, and all the fish in it are taken. Although the fiords abound with fish, as do also the mountain-streams that discharge themselves into them, it appears that these men often lie in ambush the best part of a day without taking anything,—but one fortunate capture is an ample reward."*

On the rivers and streams there is a very simple method of taking salmon in large quantities. They either make artificial embankments, or avail themselves of ledges of rocks that divide the stream into several narrow channels. On each of these channels they place two sluices, the one above and the other below, in such a manner that they can be opened and shut at pleasure. The fish, having once entered these locks, are prevented from proceeding or returning, and the water being let off, they are taken by the hand without any trouble. The method is also common in Sweden, where, on the river Deje, they often thus take from five to eight hundred salmon in a single day. The greater part of the salmon caught in the fiords are salted and exported, but many of the fish are sold fresh in the neighbouring country at the rate of about an English penny the pound. Angling seems too slow an operation for the Norwegians; but several English gentlemen, who of late years have been attracted by the romantic beauty of the country and the love of fishing, have found excellent sport in that way, particularly on the fiord where Drontheim is situated, and in the streams leading to it, which abound with salmon, salmon-trout, and other species.

Before proceeding to the next family, we venture to introduce the portraiture of a fisherman of the olden time, one famous for his skill in the gentle craft, right eloquent in the commendation of the art which he loved so well, and happy in the elucidation of its details. It is the portraiture of "one well known and as well beloved of all good men,"—of no less a personage than honest Izaak Walton himself, "the father of angling," dressed as he was wont when he left the noise and bustle of London, and betook himself to the banks of the Lea, amidst the tranquil scenery of the fresh green fields, there to watch his trembling quill, and listen the while to the milkmaid's artless song, or muse upon the beauties of nature, keenly alive to her ever-varying charms. (See page 165, Fig. 2462.)

It was in 1653 that he published 'The Complete Angler, or Contemplative Man's Recreation,' a work which, to use the words of Sir Nicholas Harris, "whether considered as a treatise on the art of angling, or as a beautiful pastoral, abounding in exquisite descriptions of rural scenery, in sentiments of the purest morality, and in an unaffected love of the Creator and his works, has long been ranked among the most popular compositions in our language." Izaak Walton was born at Stafford, on the 9th of August, 1593, and died at Winchester, on the 15th of December, 1683. His remains lie in Winchester Cathedral.

* 'Voyage en Norwège et en Suède,' par Henri Twining.

Family CLUPEIDÆ (PILCHARDS, HERRINGS, &c.).

2463.—THE PILCHARD

(*Clupea Pilchardus*). Gipsey Herring, in Scotland.

In the genus Clupea, the body is compressed, the scales are large, thin, and deciduous, the teeth minute or wanting. The dorsal fin is single; the line of the abdomen forms a sharp keel-like edge, which in some species is serrated. Branchiostegous rays eight.

The pilchard bears a strong resemblance to the herring, but instead of being found on every part of the coasts of Britain, like that fish, its geographical distribution is exceedingly limited, and in this country it is only found in any great numbers on the shores of Devon and Cornwall, chiefly from Dartmouth to Padstow, round the Land's End. It requires a warmer and more genial latitude than the herring, and though occasionally taken at Yarmouth, and as far north as Dublin and Belfast, yet these are only individuals separated by accident from the great shoal.

Pilchards frequent the French coasts, as well as those of Spain, but not in great numbers; the French fish for them in the Bay of Biscay, attracting them to their nets, by throwing overboard large quantities of the salted roe of fishes, of which they are very fond. On the southern coast of Ireland large shoals sometimes make their appearance, and about seventy years ago a tolerably productive fishery was there carried on.

The south-western coast of England, stretching further south than any other part of the United Kingdom, is, however, their most favoured haunt; and individuals are there to be found at all seasons of the year. If the causes which regulate their movements were perfectly understood, there can be no doubt but that their habits would be found directed by as wonderful a degree of instinct as that which governs other portions of the unreasoning creation, with whose history we are better acquainted. Mr. Yarrell, in his interesting account of the pilchard (vol. ii. p. 96), says,—"In January they keep near the bottom, and are chiefly seen in the stomachs of ravenous fishes: in March they sometimes assemble in schulls (shoals), and thousands of hogsheads have in some years been taken in seans, but this union is only partial and not permanent; and it is not until July that they regularly and permanently congregate so as to be sought after by the fishermen." The pilchard sometimes spawns in May, but the usual season is October. Pennant stated that their winter retreat was the same as the herring, and that the same impulses brought them from thence to our shores; but it is now clear that their migration consists merely of a change from the deep sea to the shore, and again from the shore to the deep adjacent sea. Their course generally appears to be from the west, but, like the herring, the pilchard is very uncertain in its movements. Dr. Forbes* says,—"Both the period of their arrival and departure, and also the course they take, are uncertain, and have varied greatly in different years. Fifty or sixty years since they remained on the coasts till Christmas, and the fishermen were engaged in their capture five or six months, but now the season does not last more than two or three months. Some years ago, indeed, they either did not appear at all on the Cornish coast, or only for a few weeks, or even days. In former years they also appeared first on the northern coasts of Cornwall, towards the east, from whence they proceeded westward round the Land's End, and then eastward along the southern coasts. Lately, however, they have, on some occasions, scarcely touched on the northern coasts, but have made their first appearance on the eastern parts of the south coast." The pilchard measures from nine to eleven inches in length; it contains more oleaginous matter than the herring; the body is thicker and rounder, and less compressed; the under jaw shorter; the scales larger, and forming a closer texture than those of the herring, which drop off, and are smaller and thinner; the line of the abdomen smooth. The upper part of the pilchard is a bluish green; the belly a silvery white; head golden-coloured yellow; tail dusky. The pilchard has no teeth, in which respect it differs from the herring. The dorsal or back fin of the pilchard being placed in the centre of gravity, the body will rest in an exact horizontal position if taken up by this part, whereas in the herring the dorsal fin being more backwards than the centre, the fish on being taken up by it will not remain equipoised, but the head drops downwards.

* 'Medical Topography of the Land's End,' 1833.

The stations of the pilchard fishery are St. Ives, on the northern coast of Cornwall; Mount's Bay, on the southern coast; thence eastward at St. Mawes, at Mevagissey, and to the coasts of Devon. There are two modes of fishing, one with seans and the other with drift nets. The former requires a considerable capital: about eighteen men are employed in conducting the operations of a single "concern," and three boats are necessary; while the drift nets are managed by from four to six men in a single boat. The sean fishery is carried on near the shore, the drift fishery further at sea; and while the former supplies the foreign demand, the latter is chiefly engaged in providing for the immediate consumption of the home market, as from the manner in which the fish are taken they are not so well adapted for curing as those caught by the seans.

The nets used in the sean fishery are, a stop-sean, with lead weights at the bottom, and corks at the top to keep it floating, which costs between 300*l.* and 400*l.*, being about a quarter of a mile in length and nearly 100 feet in depth; and a tuck-sean, which is made with a hollow in the middle, is one-half the size in length, and eighteen feet deeper than the larger net: it costs about 100*l.* Two boats, of about fifteen tons each, are used, in one of which the stop-sean is carried; the other, which carries the tuck-sean, is required to assist in inclosing the fish, and is called the "volyer," supposed to be a corruption of "follower;" the smaller boat, of from two to four tons' burthen, is used to carry the men to and from the shore, besides being useful when the men are engaged with the nets; it is called a "lurker," and the crew consists of the master-seaner with three of the men, while the remainder are equally divided between the other two boats. The most favourable place for the sean-fishing is a fine sandy bay. The fishermen commence their labours towards evening, proceeding at that time to the place which the fish may be expected to visit, and there they cast anchor. Should a shoal make its appearance, the master-seaner and his men are instantly on the alert, in order to ascertain the extent of the shoal, and the nature of the ground over which it is passing. As soon as the shoal is within the depth of the sean, the boat containing it is rowed round, and when they have reached the proper place, the three men whose business it is to attend to the net heave it out with the greatest dispatch. This great body of net, rope, corks, and lead, is thrown into the sea in less than five minutes. During the whole of these proceedings the movements of the fishermen are directed by signs from the master-seaner in the lurker, as the pilchard is easily alarmed. We learn from Mr. Yarrell's work, that—"The sean at first forms a curved line across the course of the fish; and while the two larger boats are employed in warping the ends together, the lurker's station is in the openings, where, by dashing the water, the fish are kept away from the only place of escape. When the sean is closed and the ends are laid together, if the body of the fish be great, and the sea or tide strong, the net is secured by heavy grapnels, which are attached to the head-ropes by hawsers. When the evening has closed in, and the tide is low, they proceed to take up the fish. For this purpose, leaving the stop-sean as before, the volyer passes within it, and lays the tuck-sean round it on the inner side; it is then drawn together so as gradually to contract the limits of the fish, and raise them from the bottom. When disturbed they become exceedingly agitated; and so great is the force derived from their numbers and fear, that the utmost caution is used lest the net should either sink or be burst. When the tuck-sean is thus gradually contracting, and the boats surround it, stones suspended from ropes, called minnies, are repeatedly plunged into the water at that part where escape alone is practicable, until the fish then to be taken are supported in the hollow or bunt of the sean."

It is stated that it is not more difficult to take a thousand hogsheads of fish than to take a single hogshead; and as the movements of a large body are slower than a smaller, the difficulty is probably less. Instances have occurred in which two thousand hogsheads, or about five million fish, have been caught at once: but when a very large number are caught, only so many are taken out of the net at one time as the boats can conveniently carry, and a week or ten days may elapse before the whole are secured. By this arrangement the process of salting or curing is properly performed; whereas, if the whole were compelled to be brought on shore at once, many would be spoiled, from the impos-

sibility of getting through the work in proper time. The fish are brought to the surface by a small net, and two men with a large basket bale them out of the net into the boat. When the fishery is carried on beyond the usual distance from the coast, as at Mount's Bay (see Fig. 2464, Pilchard Fishing in Mount's Bay), the fish are conveyed to the shore in small sloops of a few tons' burthen. In ordinary cases it is conveyed by the sean boats. At St. Ives huers are employed, though at all the other stations they have been discontinued. The huers, according to Mr. Yarrell, are "men posted on elevated situations near the sea, who by various concerted signals made with a bunch of furze in each hand, direct the fishermen how best to surround a schull of fish." They perform the part which is now assigned to the master-seaner in the lurker. In some seasons there are what is called the first and second catch; the latter being at a period when the season has in other years generally terminated.

The fishing by drift or driving nets is generally carried on in common fishing-boats, manned by four men and a boy. These boats have generally either lug-sails or sprit-sails; and there are often as many as twenty nets to each boat, the whole of which being joined together extend three-fourths of a mile in length, though they may be much shorter,—the excellence and superiority of the tackle depending upon the extent of the fisherman's capital.

The fish, on being brought to the shore, are at once taken to the cellars or storehouses, where they are salted and ranged in heaps, from five to six feet in height, and in some instances ten or twelve feet wide. After remaining in this state for five or six days, they are packed into hogsheads. By the application of a powerful lever at the top of the hogshead, the oil is extracted, and runs out of the casks through holes made for the purpose. The pressing continues for about a fortnight. The refuse salt, which is mixed with the scales and blood of the fish, is sold as manure to the farmers, and is applied with great advantage to the land. It is estimated that the refuse of each pilchard will manure one square foot of land.

It is computed that forty-eight hogsheads of pilchards will yield two hundred and fifty-two gallons of oil. In 1801 a tun of this oil was worth from 20*l*. to 25*l*., but is now of much less value. Five bushels of salt, of eighty-four pounds each, are required in curing one hogshead of pilchards, which contains about three thousand fish, and weighs between five and six hundredweight. A stock of three thousand bushels is the average consumption of salt by a single sean in a favourable season.

2465.—THE HERRING

(*Clupea Harengus*). Contrary to the opinion of Pennant and other naturalists, the herring is a resident in the deep water all round our coast, and only approaches the shores for the purpose of depositing its spawn, which accomplished, it returns to the deep. Pennant, however, describes the shoals as making the Arctic circle their winter rendezvous; and on their return he says they first make their appearance off the Shetland Isles in April and May; but these, he adds, are only forerunners of the grand shoal which comes in June; and their appearance is marked by certain signs, by the numbers of birds, such as gannets and others, which follow to prey on them: but when the main body approaches, its breadth and depth are such as to alter the very appearance of the ocean. It is divided into distinct columns of five or six miles in length, and three or four in breadth, and they drive the water before them with a kind of rippling; sometimes they sink for the space of ten or fifteen minutes, then rise again to the surface, and in bright weather reflect a variety of splendid colours. The first check this army meets in its march southward is from the Shetland Isles, which divide it into two parts. One wing takes to the east, the other to the western shores of Great Britain, and fill every bay and creek with their numbers. Others pass on towards Yarmouth, the great and ancient mart of herrings; they then pass through the British Channel, and after that in a manner disappear. Those which take to the west, after offering themselves to the Hebrides, where the great stationary fishery is, proceed towards the north of Ireland, where they meet with a second interruption, and are obliged to make a second division. The one takes to the western side, and is scarce perceived, being soon lost in the immensity of the Atlantic; but the other, which passes into the Irish Sea, rejoices and feeds the inhabitants of most of the coasts that border on it."

Now so far from this migration to and from the Arctic circle taking place, it would appear that the herring has never been seen by voyagers or whale-fishers in those high northern latitudes. On the southern coast of Greenland "some few of the large sort of herrings are taken," says Crantz, and he previously states that the Angmarset, a small herring about six inches long, is the common food of the Greenlanders, and this species was found by Sir John Franklyn on the shore of the Polar basin. No great shoals of the common herring, however, have been observed. If this fish does not make the Arctic circle its asylum, so on the other hand it never visits the warmer latitudes, nor farther south than the adjacent parts of the coast of France. The extent of its migratory movements then is very limited, from the shore to the deep sea, and from the deep sea to the shore. The common herring spawns in October or the beginning of November; and two or three months previous to this, generally in the middle of July, when the fish are in high condition, the shoals collect off various parts of our coast, at which period the fishery, of such national importance, is carried on; after spawning the shoals depart, but young herrings, which, unlike the salmon, do not mature their roe for the first year, abound in the shallows around our coast throughout the winter, and during the whole of the summer, and are often caught in small meshed nets used for taking sprats, atherine, and other fishes.

It is a remarkable circumstance in the history of the herring, that the shoals are extremely capricious with respect to the localities they visit, and that too without any accountable reason. For years they will resort by myriads to a given station, which will then be deserted, and some portion of a coast where they have previously been extremely rare will become thronged with countless multitudes. There is scarcely a fishing station, says Mr. Yarrell, round the British islands that has not experienced in the visits of this fish the greatest variations, both as to time and quantity. These frequent changes of their haunts have led to many speculations. "Ordinary philosophy," says Dr. McCulloch, "is never satisfied unless it can find a solution for everything, and is satisfied for this reason with imaginary ones. Thus in Long Island, one of the Hebrides (a great fishing station in the time of Charles the First), it was asserted that the fish had been driven away by the manufacture of kelp; some imaginary coincidence having been found between their disappearance and the establishment of that business. But the kelp fires did not drive them away from other shores, which they frequent and abandon indifferently without regard to this work. It has been a still more favourite and popular fancy that they were driven away by the firing of guns, and hence this is not allowed during the fishing season. A gun has scarcely been fired in the Western Islands or on the west coast since the days of Cromwell, yet they have changed their places many times in that interval. In a similar manner, and with equal truth, it was said they had been driven from the Baltic by the battle of Copenhagen. It is amusing to see how old theories are revived. This is a very ancient Highland hypothesis, with the necessary modification. Before the days of gunpowder the Highlanders held that they quitted the coasts where blood had been shed; and thus ancient philosophy is renovated. Steam-boats are now supposed to be the culprits since a reason must be found: to prove their effect, Loch Fyne, visited by a steam-boat daily, is now their favourite haunt, and they have deserted other lochs where steam-boats have never yet smoked." Mr. Yarrell gives a ludicrous example of one reason why herrings desert an old station; his words are,—"A member of the House of Commons during the sessions of 1835, in a debate on the tythe bill, stated that a clergyman having attained a living on the coast of Ireland, signified his intention of taking the tythe of fish, which was, however, considered to be so utterly repugnant to their privileges and feelings, that not a single herring had ever since visited that part of the shore."

The food of the herring consists of small crustacea and fishes; and it would appear that they do not spare the young of their own race, for Dr. Neill found five young herrings in the stomach of a large female. They have been caught by anglers with an artificial fly, and the fishermen have not unfrequently taken them with lines, the hooks having been baited with limpets. It is doubtless to the quality and supply of food which different stations present, that the superiority of the herrings of one place to those of another is to be attributed. Mr. Jesse, in his 'Gleanings in Natural History,' states that the herrings of Cardigan Bay are much superior to those taken at Swansea. Abundance of nutritive food, we may readily suppose, will tend to the development of the roe; and shoals that have luxuriated on a perpetual feast are perhaps those which appear the soonest on our coasts. At all events the herring season is not at precisely the same time in every place. For example, on the western coast of Scotland the fishery has sometimes terminated before that on the eastern coast has commenced; it has sometimes in a southern part of the coast than farther north, and on the western coast of the county of Cork before any other part of the United Kingdom. These facts, moreover, militate against the once universally received theory of their simultaneous arctic migration and return.

The herring dies almost the instant that it is taken out of the water, and this in some measure results from the width of the gill-openings. But it is to be observed that "those fish which swim near the surface of the water have a high standard of respiration, a low degree of muscular irritability, and great necessity for oxygen, die soon, almost immediately when taken out of water, and have flesh prone to rapid decomposition: mackerel, salmon, trout, and herrings are examples. On the contrary those fish that live near the bottom of the water, have a low standard of respiration, a high degree of muscular irritability and less necessity for oxygen; they sustain life long after they are taken out of the water, and their flesh remains good for several days: carp, tench, eels, the different sorts of skate, and all the flatfish may be quoted" (Yarrell).

The destruction made by man, by gannets, and other water birds, and by larger fishes amongst the shoals of herrings, is almost incalculable; yet their numbers appear undiminished, myriads supplying the places of the myriads destroyed. The roe of the herring weighs four hundred and eighty grains, and is composed of eggs varying in number from three to four thousand. Thus it is then that this fish, by the economy of a wise Providence, yields to man a never-failing supply, the balance between loss and increase being duly maintained.

As we have said, the herring fishery is only carried on during spawning season, or rather before it, when the fish are in the highest perfection. The Yarmouth herring fishery commences about the middle of September, but the season varies at different parts of the coast. On the coast of Sutherland the early herring fishery commences in June; the late fishery about the middle of July, and continues until September. On the coast of Cromarty large shoals appear as early as the month of May. The great object is to obtain a supply for the purpose of curing, although in the early part of the season, large numbers of fresh herrings are brought to the London market from Yarmouth; and the consumption at Norwich and other places, which are not at a great distance from the coast, is also considerable. The fish are sometimes so rich in the early part of the season as to be unfit for curing, and on this account they are brought into the market for immediate consumption. The spawning season being over by the end of October or the beginning of November, the fishing terminates, as the herrings are then in a poor and exhausted condition.

The size of the boat used in the herring fishery depends upon the distance from the shore at which the fishery is intended to be carried on, and also as to whether the intention be to cure red herrings or white herrings. As red herrings must be cured on shore, while white herrings require only to be salted and put into barrels, those who are engaged in the red herring trade find it convenient to keep within a certain distance of the coast. The white herrings may be cured on board the vessel; and as the fishermen may go out to sea wherever the fish are to be found, this is called a deep-sea fishery, and of course a vessel of a larger description is required than when the cargo has to be taken as speedily as possible to the drying-house. The business at Yarmouth is entirely in red herrings, which are in the greatest demand for the home market, while the export trade, carried on at other ports, chiefly consists of white herrings. The same men are in general acquainted with each mode of curing. The vessels fitted out for the deep-sea fishery meet with the earliest and best herrings; and, owing to the manner in which herrings desert parts of the coast which they have been accustomed to frequent, it is a more permanent source of profit than the boat fishery, though it requires a large capital. The vessels must contain sufficient room in the hold for the stowage of salt, nets, barrels, and provisions. They lie low in the water, and the sides are furnished with rollers and lee-boards to facilitate the drawing in of the nets. The Dutch, who pursued the deep-sea fishery, and once carried it on with great spirit and success, were usually provided with a double set of nets for fear of accident; as their distance from port would have rendered the loss or destruction of one set a matter of serious consequence, and the hopes of a whole season might have been lost. The Yarmouth boats are generally of about fifty tons' burthen, and manned with eleven or twelve men, of whom one-fourth are usually landsmen. In addition, there are two landsmen who are employed in ferrying to and from the decked vessel, and in curing the herrings on shore. The fishing places are from fifteen to thirty miles north of Yarmouth, from thirty to forty-five miles to the eastward, and the boats go southward as far as the mouth of the Thames and the South Foreland. The depth of water in which the fishery is carried on is from fifteen to twenty fathoms. The Yarmouth fishing

2467.—Herring-boats at Yarmouth Jetty.

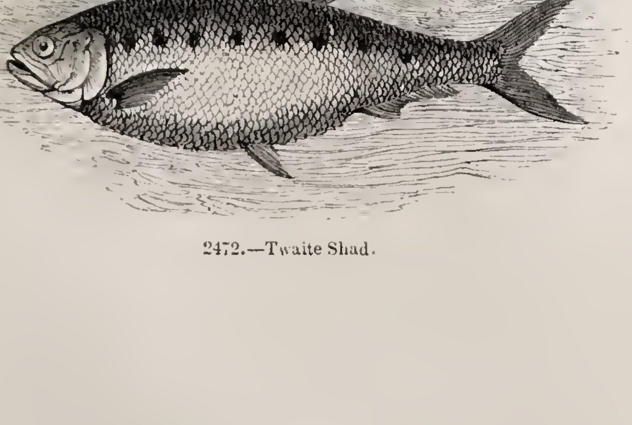
2468.—Yarmouth Beach-cart with Fish.

2466.—Herring-fishers on Yarmouth Beach.

2462.—Izaak Walton.

2469.—Cornish Fisherwomen of Mount's Bay.

2470.—Sprat.



2472.—Twaite Shad.

2471.—Sprat-fishing in the Thames, off Purfleet.

vessels are fitted out at a cost of about 1000*l.* each. Each of them is furnished with from one hundred and eighty to two hundred nets, which cost between 300*l.* and 400*l.*; and with six ropes, each one hundred and twenty fathoms in length, weighing separately from four to four and a half hundredweight, and of the total value of 50*l.* or 60*l.* These nets and ropes require to be renewed nearly every fourth year, owing to the destructive effects of the sea and the ravages of dog-fish, which, in preying upon the herrings when they are inclosed within the nets, injure the nets themselves.

As illustrations of the above account, we refer to the following figures; Fig. 2466, the Beach at Yarmouth; fishermen going out: Fig. 2467, the Yarmouth Jetty; herring-boats returned: Fig. 2468, Yarmouth Beach-cart for carrying the produce of the fishing boats to the town. Extensive fisheries are carried on along the coast of Scotland.

We may here observe that a second species of herring (Leach's herring, Clupea Leachii, Yarrell) visits our coast in autumn: it is of superior quality. This species deposits its spawn in February, and is perhaps the first of the three kinds said to visit the Baltic; these are the strombling or small spring herring, which spawns when the ice begins to melt, a larger summer herring, and lastly the autumn herring, which makes its appearance towards the middle of September. The length of Leach's herring is only seven and a half inches, it is however deeper than the common herring in proportion to its length.

Fig. 2469, Cornish Fisherwomen from the neighbourhood of Mount's Bay.

These women wait the return of vessels engaged in the fishery of herrings, pilchards, mackerel, &c.; with these they fill their willow 'cauwals' or deep baskets, which they carry on their backs to different towns near the coast, in order to dispose of the contents.

2470.—THE SPRAT

(*Clupea Sprattus*). Garvie Herring in Scotland.

For a long period this fish was regarded by naturalists as the young of the herring or the pilchard, but the specific difference is now well established, and a momentary glance is sufficient to enable the observer to detect the sprat among the young of the pilchard or herring of its own dimensions. In the sprat the line or ridge of the abdomen is strongly serrated, so that by the feel alone the distinction may be appreciated.

Like the herring, the sprat moves in vast shoals, which in summer frequent the deep water, advancing towards the close of autumn towards the shore; they then enter bays, and advance up rivers, in numbers incalculable. Early in the month of November the fishing season commences, and continues during the winter; and not only are the London and other markets supplied by bushels, but tons are used as manure, for the wheat lands and hop-grounds of our south-western counties; and if judicious regulations were adopted, the demand for this purpose might benefit the fishermen without a decrease of the quantity sent into the markets for consumption.

In Sir Humphry Davy's 'Elements of Agricultural Chemistry,' a work with which it is to be regretted farmers are so seldom acquainted, the following account is given of the use of fish as a manure:—"Fish," observes this eminent chemist, "forms a powerful manure, in whatever state it is applied; but it cannot be ploughed in too fresh, though the quantity should be limited. Mr. Young records an experiment, in which herrings spread over a field, and ploughed in for wheat, produced so rank a crop that it was entirely laid before harvest. The refuse pilchards in Cornwall are used throughout the county as a manure with excellent effects. They are usually mixed with sand or soil, and sometimes with sea-weed, to prevent them from raising too luxuriant a crop. The effects are perceived for several years. In the fens of Lincolnshire, Cambridgeshire, and Norfolk, the little fish called sticklebacks are caught in the shallow waters in such quantities, that they form a great article of manure in the land bordering on the fens. It is easy to explain the operation of fish as a manure. The skin is principally gelatine, which, from its slight state of cohesion, is readily soluble in water; fat or oil is always found in fishes, either under the skin or in some of the viscera, and their fibrous matter contains all the essential elements of vegetable substances. Amongst oily substances blubber has been employed as manure. It is most useful when mixed with clay, sand, or any common soil, so as to expose a large surface to the air, the oxygen of which produces soluble matter from it. Lord Somerville used blubber with great success at his farm in Surrey. It was made into a heap with soil, and retained its power of fertilizing for several successive years. The carbon and hydrogen abounding in oily substances fully account for their effects, and their durability is easily explained from the gradual manner in which they change by the action of air and water." The quantity of sprats used as manure now amounts, it is believed, to many thousand tons each year. The price varies from tenpence to one shilling and three pence, and sometimes has been as high as one shilling and sixpence per bushel: in 1829 large quantities were purchased at sixpence per bushel. About forty bushels per acre is the quantity usually applied. Barge loads, containing one thousand five hundred bushels, were sent up the Medway to Maidstone in 1829, and the hop-grounds were abundantly manured; and so near London as Dartford the farmers enrich the land with this species of manure.

The fishing season commences, as we have said, in November, and the foggy and gloomy nights which prevail at that period are considered most favourable to the fishermen. The finest fish are caught in the same manner as mackerel, but the largest quantities are taken by the stow-boats, manned with five or six men. Mr. Yarrell (p. 123, vol. ii. 'British Fishes') gives the following description of this mode:—"The stow-boat net goes with two horizontal beams: the lower one, twenty-two feet long, is suspended a fathom above the ground; the upper one, a foot shorter in length, is suspended about six fathoms above the lower one. To these two beams, or "balks," as they are called, a large bag net is fixed, towards the end of which, called the hose, the mesh is fine enough to stop very small fry. The mouth of the net, twenty-two feet wide and thirty-six feet high, is kept square by hanging it to a cable and heavy anchor at the four ends of the beams. The net is set under the boat's bottom; and a rope from each end of the upper beam brought up under each bow of the boat, raises and sustains the beam, and keeps the mouth of the net always open, and so moored that the tide carries everything into it. A strong rope, which runs through an iron ring at the middle of the upper beam, and is made fast to the middle of the lower beam, brings both beams together parallel, thus closing the mouth of the net when it is required to be raised." The meshes of the net are so small, that a pen could scarcely be inserted in them, and nothing but water will pass through. Hence the destruction of small fry is immense, and it is alleged that the scarcity of turbots, brills, soles, and other fish in those parts of the coast where they were once abundant is occasioned by the stow-boats. Some of the fishermen state that about twenty years ago large quantities of soles and a few turbots were caught off the coast of Kent without difficulty, but that these fish have now become scarce, and the fishermen are not in consequence so well off.

A committee of the House of Commons on the British Channel Fisheries, which sat in 1833, made the following observations on this point, and recommended some interference:—"This branch of fishing (it is observed in the Report) has greatly increased, and there are at present from four hundred to five hundred boats engaged in stow-boating on the Kentish coast only, which remain upon the fishing-grounds frequently for a week together, not for the purpose of catching sprats, or any other fish to be sold as food in the market, but until they have obtained full cargoes of dead fish for the purpose of manuring the land. Now from the very destructive nature of this fishery, its being of modern introduction, and considering also the almost boundless extent to which a demand for its produce may be carried, if the system be permitted to continue without restriction, your committee have been inclined to question whether its further prosecution ought not to be entirely prevented; but upon the best consideration which they have been able to give to the subject, they recommend that at least it should not be permitted to be carried on with ground or drag nets, between the 1st of April and the last day of November in every year; nor with drift or floating nets in the bay during the breeding season, namely, from the 1st day of May to the last day of August, within a league of the low-water mark, or in less than ten fathoms' water; nor at any other time with nets of so small a mesh as is now generally used." None of these recommendations have yet been adopted.

The sprat is most abundant on the coasts of Norfolk, Suffolk, Essex, and Kent; but like the herring this fish is capricious in its movements. About fifty years since vast shoals made their appearance off the coast of Devon, which is now regularly visited. In Scotland the sprat is comparatively rare, and is sold in Edinburgh market by the dozen. In Cornwall, the true sprat is seldom seen, but the name is appropriated to the fry of the herring and pilchard; and per contra on the eastern coast of England, where the true pilchard is rare, the term pilchard is given to the fry of the shad, and the half-grown herring.

The sprat is occasionally taken on the coasts of Cork, Dublin, and Belfast.

Those who live in or near London, and those who have passed a winter in London, well know the abundance of the sprat in the markets. Bushels are seen from day to day in the fishmongers' shops, and bushels are cried about the streets; London and its suburbs are deluged with sprats, sold, not by the dozen, but by rough measurement, at a cheap rate. Nor is their consumption confined to the humbler classes; though rich and oily, the sprat is an excellent fish, and a dish, hot from the gridiron, finds favour even with the wealthy.

From its small size, a full-grown sprat measuring only about six inches, this fish is never cured like the herring, and is always sold fresh.

The upper parts of the back are of a dark blue with green reflexions, passing into silvery white on the sides.

Fig. 2471 represents a Sprat-boat fishing off Purfleet in the Thames.

2472.—THE TWAITE SHAD

(*Alosa finta*). In the genus Alosa there is a deep notch in the centre of the upper jaw.

Two species of shad inhabit our seas, the Alliee shad (Alosa communis), and the present, both sea fishes which enter high up our rivers to deposit their spawn; the latter being abundant in the Severn, but little known elsewhere.

The twaite shad, which is the Clupea Alosa of Linnæus, differs from the alliee shad, with which many have confounded it, in being of much smaller size, averaging from twelve to sixteen inches in length, in having a lateral row of spots, in possessing teeth while the allice shad is toothless, and in the last fin below being comparatively smaller. The twaite shad moreover is much more widely distributed. It is common in the Thames, where it advances as high as Greenwich, but formerly it was abundant in the Thames at Millbank above Putney Bridge. It visits the Severn, and is occasionally taken off the coast of Norfolk. Northwards its range is very extensive; Professors Nilsson and Reinhardt enumerate it among the fishes of Scandinavia.

It is in the month of May that this fish works its way up our rivers, and those of the adjacent continent, in order to deposit its spawn, which accomplished it returns to the sea towards the end of July. In the Thames it is caught in considerable abundance, but the fishing is not allowed after the 30th of June, in order that the survivors may not be interrupted in the great purpose for which they visit the river. The flesh, however, of the twaite shad is very inferior to that of the alliee, being dry and full of bones.

The young both of the twaite and alliee appear to grow very slowly. With respect to the former, Mr. Yarrell says, "I have obtained the young only two inches and a half long in October;" and he adds that in the following spring he found them only four inches long, and the young of the larger allice shad (which when adult is from two to three feet in length) only six inches.

The food of the shad consists of small fishes and various kinds of crustacea, as shrimps, &c.

The twaite shad has the line of the abdomen strongly serrated; the top of the head and back is dusky blue with brown and green reflexions; the sides are silvery white, with a coppery tinge, and a row of six or more dark spots from the edge of the gill-orifice to the tail. The mucous vessels on the surface of the gill-covers are beautifully arborescent.

2473.—THE ANCHOVY

(*Engraulis encrasicolus*). Clupea encrasicolus, Linn.; Engraulis vulgaris, Cuv.

In the genus Engraulis, the head is pointed, the upper jaw the longest; the mouth deeply divided, the gape extending backwards beyond the line of the eyes. Branchial apertures large, the ventral fins somewhat anterior to the line of the commencement of the dorsal. Abdomen smooth. Branchiostegous rays twelve.

From the earliest times, the anchovy has been celebrated, and a sauce or condiment prepared from it, called garum or γαρον, was in high estimation among the Greeks and Romans.

The anchovy is abundant in the Mediterranean, and along the coasts of Spain, Portugal, and France, and extends thence northwards, being occasionally found in the Baltic. It occurs also on various parts of our coast, as Hampshire, Cornwall, Wales, &c.; and is said to be frequently sold in the Liverpool market.

In general the anchovy measures from four to five inches in length, but occasionally it is found much larger. Mr. Yarrell quotes a statement of Mr. Couch, who says, "I have seen it in the Cornish seas of the length of seven inches and a half; and I have met with specimens from autumn through winter to the middle of March; it is therefore probable that a fishery might be established with good prospect of success, for though the nets employed

for other fish can take but few of them, the numbers found in the stomachs of the whiting and other ravenous fishes show that they are in considerable abundance."

In preparing this fish for use the head and viscera are always removed, otherwise the pickle would be intensely bitter; it was in fact supposed to have the gall in its head.

ORDER MALACOPTERYGII continued.

SECTION SUBBRACHIALES.

In this section the ventral fins are attached under the pectoral fins, the bones of the former being attached to the bones of the shoulder, supporting the latter.

Family GADIDÆ (COD-FISH, COAL-FISH, &c.).

In this family the ventral fins, seated under the pectorals, are pointed; the scales are soft; the flesh is white, separates into flakes, and is wholesome.

The common cod-fish, a native of the northern seas universally, is a typical example. In the United Kingdom alone, the cod fishery gives employment to thousands; to say nothing of the great fishery on the banks of Newfoundland. There appear to be two distinct varieties of the cod-fish; one of which, called the Dogger Bank Cod, has a sharp nose elongated before the eye, and the body of a very dark colour; the other has a round blunt nose, short and wide before the eyes, and the body of a light yellowish ash green. It is frequently called the Scotch Cod. The former prevails along our southern coast; the broad-nosed fish is mostly confined to the north. Both varieties occur on the coast of Northumberland, and at the Isle of Man, where, perhaps from some peculiar food, they acquire a reddish brown colour, and are called Red Cod, or Ware Cod.

The Cod-fish (Morrhua vulgaris) has three dorsal fins, two posterior fins below, and one barbule on the chin.

This well known fish is very voracious, devouring smaller fishes, various kinds of mollusks, and crustacea, and it readily seizes a bait: hence it is fished for with lines and hooks. In the deep sea, off the Cornish coast, bulters are used, that is, long cords with smaller cords at given intervals attached to them, of about six feet in length, and furnished with hooks; these smaller lines are called snoods, and the distance between each snood is double that of its own length, to prevent entanglement. The baits used are portions of fish, whelks, limpets, &c., and thus prepared the bulters are laid across the tide, their extension being secured by means of anchors or grapnels, and buoys are attached by ropes to each end of the line. Were this line not laid or shot across the tide, but longitudinally in the direction of its ebb and flow, the hooks would all be forced together, and the period of one tide's fishing inevitably wasted. It is usual to lay the lines at the time of slack water, between each ebb and flow; and they are left for one flow and ebb, and then hauled up for examination. Besides bulters, hand-lines are also used, each line armed with two hooks; two of such lines are managed by one man, and a single individual has been known to take from four hundred to five hundred and fifty fish on the banks of Newfoundland in the course of ten or eleven hours.

Cod-fish are brought alive in well-boats up the Thames as high as Greenwich, where the water is still sufficiently saline to keep the fish alive. These well-boats, in which the live fish are stored, are stout cutter-rigged vessels of eighty or one hundred tons' burthen; they contain a large well, stocked with the cod-fish, and of these a supply is sent every night to Billingsgate, where the fish arrive still quivering with life. The cod spawns about February, and Mr. Yarrell informs us that nine millions of eggs have been found in the roe of one female. This fish, and indeed all the Gadidæ, as Whitings, Haddocks, &c., are in the greatest perfection as food from October to Christmas.

Young cod-fish abound at the mouth of the Thames, and along the coast, and on various sandbanks in the Channel, and may be easily captured with hand-lines.

Cod-fish, says Mr. Yarrell, have been kept in salt-water ponds in different parts of Scotland; and are found to maintain their condition unimpaired. "Of these ponds there are three, one in Galloway, another in Fife, and a third in Orkney. That in Galloway is at Logan, the seat of Colonel M'Dowall; it is a basin of thirty feet in depth, and one hundred and sixty in circumference, hewn out from the solid rock, and communicating with the sea by one of those fissures so common to bold and precipitous coasts. A fisherman is attached to this preserve, whose duty it is constantly to supply the fish with the necessary quantity of food, which several species soon learn to take eagerly from the hand. In the course of the fishing for this daily supply, such fish as are not too much injured are placed in the reservoir; the others are cut up in pieces for food for the prisoners. The whelks, limpets, and other testacea are boiled to free them from the shells: and no sooner does the keeper or his son appear with the well known basket of prepared food, than a hundred mouths are simultaneously opened to greet the arrival. The cod-fish are the most numerous in this preserve; and one of them has lived twelve years in confinement and attained to a large size." Allied to the cod-fish are the following, which we may just enumerate:—the Dorse, or Variable Cod (Morrhua callarias), common in the Baltic; the Whiting-pout or Bib (M. lusca); the poor or Power Cod (M. minuta); the Speckled Cod (M. punctata); the Pollack (Merlangus Pollachius); the Green Cod (M. virens); the Hake (Merlucius vulgaris); the Ling (Lota molva), from the liver of which is extracted an oil, sometimes administered internally as a medicine, and useful in rheumatism; the Barbot (Lota vulgaris). A few other species we shall more fully notice.

2474.—THE WHITING

(*Merlangus vulgaris*). In this genus there is no barbule at the chin; the other characters are as in Morrhua.

The whiting is common in our seas, preferring sandy banks as its haunt; it may be caught with lines throughout the greater part of the year; but in the months of January and February, when it approaches our coast in shoals for the purpose of breeding, it is the most abundant. Like the cod, the whiting is a voracious feeder, and often shifts its ground in pursuit of the hordes of fry, which wander about themselves in quest of prey, and becoming in turn the prey of others.

The London markets are well supplied with this fish, which is celebrated for the whiteness and delicacy of its flaky flesh; we seldom see it more than fifteen or sixteen inches in length, and of a pound and a half in weight; sometimes, however, specimens occur weighing three or four pounds, and we were lately informed of one, by a gentleman who partook of it, which weighed seven pounds.

2475.—THE COAL-FISH

(*Merlangus carbonarius*). This species is a native of our seas, its range being extended to the shores of Spitzbergen and Davis's Straits. In the Baltic and around the Orkneys this fish swarms in vast shoals; it is found also on the Cornish coast, and along various parts of the coast of Ireland. Though by no means remarkable for the excellence of its flesh, yet as it affords a cheap and abundant supply of food, vast numbers are taken in the islands of Scotland; the young are preferred for immediate use, those which weigh twenty or thirty pounds are usually salted and dried. The coal-fish, according to Mr. Couch, is in the highest condition from October to December, at which season it prowls after prey in large shoals, which often prove a valuable capture to the fishermen. "They swim at no great depth, and with great rapidity, but when attracted by bait will keep near a boat until all are taken; and I have known four men with two boats (two men in each boat) take twenty-four hundredweight with lines in a very few hours. The season for spawning is early in spring; immediately after which this fish becomes so lank as to be worthless, in which state it continues through the summer."

The provincial names of this fish are very numerous. The adults are called by the Cornish fishermen Rauning (ravening) Pollacks; in the islands of Scotland it is termed Sillock, Pillock, Cooth, or Kuth, Cudden, Sey, Sethe, and Grey-Lord; around the Forth the young are called Podleys; at Newcastle, Coalsey, and when twelve inches long, Poodlers; in Ireland it is known as the Black Pollack, Blocking, and Grey-Lord. (See Yarrell.)

The colour of this fish on the back to the lateral disc is almost black; below, the tint is paler, and passes into white with golden reflexions on the under parts; lips tinged with purple red; mouth black; irides silvery white.

2476.—THE THREE-BEARDED ROCKLING, OR SEA LOCHE

(*Motella vulgaris*). In the genus Motella the body is elongated, cylindrical, and compressed posteriorly. The first dorsal fin is very slightly elevated, delicate in structure, and scarcely perceptible; the second dorsal and the last under fin are long, and continued almost to the base of the tail fin. The three-bearded rockling is a rare fish, being seldom seen on any of our shores, excepting those of Cornwall and Devonshire, where it frequents the submerged rocks covered with luxuriant fronds of sea-weed, among which it lurks and ploughs its way in quest of food. It is not a deep-water fish, but gives preference to the shallows, where it procures small crustacea, on which it principally subsists. It is seldom used as food, its flesh becoming unpleasant in a few hours.

This fish is La Mustèle Commune of Cuvier; Gadus Mustela of Linnæus; the Weasel or Mustela of the Romans; Ray terms it Mustela marina: Pennant states that it was called Whistle-fish from the fact of Cornish fishermen whistling when desirous of taking it, as if by that means its capture was facilitated; but Mr. Yarrell could not find that such a custom was or had been practised, and he suspects, we think with reason, that Whistle-fish was a mistake, and that Weasel-fish should have been written.

The three-bearded rockling is from fifteen to seventeen or eighteen inches in length; there are two barbules on the snout above, and one on the chin. The general colour is rich yellow brown, spotted with deep chestnut; under parts pale and unspotted.

2477.—THE FIVE-BEARDED ROCKLING

(*Motella quinquecirrhata*). This species when full grown attains the length of eighteen or twenty inches, and in habits and food resembles the preceding; frequenting rocky and stony shallows, where it conceals itself under tufts of sea-weed, in fissures, and under fragments. It is more common than the three-bearded rockling, and Mr. Yarrell has observed it of small size in abundance along the Kentish coast in autumn, extending thence westward as far as Portland Island. According to Mr. Low it is common about the Orkneys. It has been taken at Dublin and Belfast. The general colour of this fish is pale bronze, of a golden tint, with streaks of purer gold above the lateral line in the direction of the ribs. The fins are of a brownish orange margined with red. There are four barbules on the snout above, and one on the chin.

2478.—THE TORSK

(*Brosimus vulgaris*). The genus Brosimus differs from Motella in the dorsal fin being single, and there is only one barbule at the chin.

The torsk is a native of the northern seas, scarcely occurring below 60°, or above 73°; it is abundant on the coasts of Norway, around the Faroe Islands, and off the west and south coasts of Iceland. It is not uncommon around the Orkney Islands, and swarms among those of Shetland. This fish lives in deep water having a rocky bottom covered with luxuriant sea-weeds, and in the islands of Scotland is caught with lines and hooks in the same manner as ling and cod, and is salted and dried in the same manner. In this state the flesh when boiled is excellent, but it is firm and rather tough when eaten fresh. In Scotland the torsk forms a considerable article of commerce, and is either dried or barrelled for sale. In Norway, we believe, it forms no branch of merchandise.

The torsk is from eighteen inches to upwards of two feet in length; the fins are thick and soft; the head is dusky; the back and sides yellow, gradually merging into white. The fins are dusky brown, the edges of all, excepting the pectoral and ventral, being abruptly white; the head in proportion to the body is small.

Fig. 2479 represents one of the Fish-barks of St. Petersburg, floating fishmongers' shops, in which are bought and sold all the fish consumed in that capital during the summer. This ark is surrounded by numerous floating cisterns and boats, either pierced with small holes to admit the clear waters of the Neva, or filled with salt water for the natives of the sea. In these are kept various kinds of fish alive, while the bark is the fishmonger's residence, which communicates with the quay by means of a railed plank. On the application of a customer for fish, the person is conducted down a sloping plank to the reservoirs, and makes choice of the fish, which are secured by means of a small landing-net; those which are not approved being returned to the proper vessels. In winter this mode cannot be practised, for the water is ice, and besides all sorts of food, as "fish, flesh, and fowl," are frozen as hard as wood.

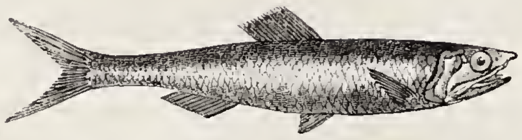
Fig. 2480 represents an animated scene (from a celebrated painting by Leopold Robert of Neufchâtel), representing "Le départ des Pêcheurs de l'Adriatique pour la pêche de long cours," or in other words, the fishermen of the Port of Chioggia near Venice, preparing to depart for the deep-sea fishing. How different such a scene from that which presents itself on the beach at Hastings or Yarmouth, or any of our British fishing-ports! yet it is very characteristic.

Family PLEURONECTIDÆ (PLAICE, TURBOT, SOLES, and FLAT-FISH generally).

The Flat-fishes, as soles, &c., are so well known, that were not some errors popularly entertained respecting their form, we might well refrain from entering into minute details; the upper surface of

2476.—Three-bearded Rockling.

2478.—Torsk.



2473.—Anchovy.

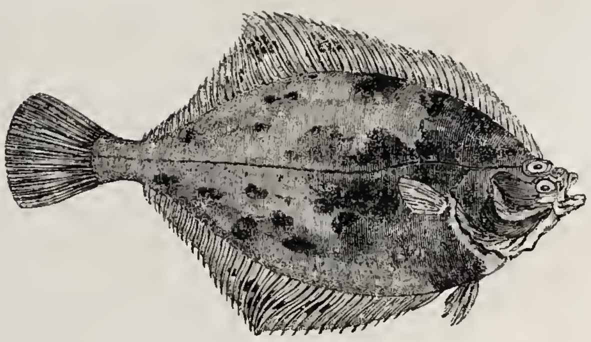
2479.—Fish-bark of St. Petersburg.

2475.—Coalfish.

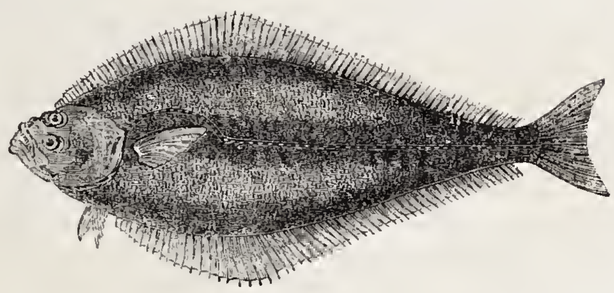
2474.—Whiting.

2477.—Five-bearded Rockling.

2483.—Fishing boat off Havre-de-Grace.



2482.—Flounder.



2481.—Dab.

2480.—Fishermen of Chioggia, near Venice.

these flat-fish, as it is called, is dark coloured, the under surface white. Now these are really the two sides of the fish, and not the back and abdomen; the back is in reality the ridge extending from the upper jaw to the tail, along which runs one extensive dorsal fin. The abdominal cavity is small and posterior to the gills, and on it are placed the two ventral fins (see Fig. 2481, the Dab); the pectoral fins are placed one behind the gill-cover, the other on the opposite side, and it is seldom that these two are equal; the pectoral fin below runs from behind the posterior fins to the tail, and is nearly equal in extent to the dorsal fin. With respect to the head, it is as if it had been wrenched round, and crushed flat, the bones all distorted, the two eyes both brought to one side, and the mouth twisted in the same direction. Cuvier says the osseous structure of the head is curious from this distortion (renversement), which brings the two orbits to the same side; nevertheless we find in it the parts common to the skull of other fishes, but unequally developed. Such, then, are these flat-fishes, which belong to the subbrachial malacopterygians, and their habits harmonize with their external contour. They have no air-vessels, and they tenant the bottom of the water, lying flat on the white side, on the muddy or sandy bed; while from the position of the eyes they are enabled to gaze above and around, watching for prey, or marking the actions of their foes, while the dark colour of the side uppermost, blending with that of the bed on which they lie, tends to their concealment. In general they swim slowly and with a slightly undulating motion, maintaining the dark side uppermost; and seldom rise to any elevation above the bed of the water, but when alarmed or disturbed they suddenly assume a vertical position, and dart along like a flash, showing for a moment the white under-side, but soon re-assume their previous posture, continue to undulate along, and ultimately settle quietly on the muddy bed. We once saw a beautiful exhibition of this kind while crossing the Severn near Bewdley in a flat-bottomed boat. In the clear water below, we beheld a large shoal of flounders pursuing their course; they looked like an army of rats running along the bed of the river: on a long pole being struck down among them, with a sudden simultaneous movement they assumed a vertical position, darted forwards, and passed out of sight. The flat-fishes are very tenacious of life; of most the flesh is in high estimation for the table, the turbot, indeed, holds a pre-eminent place in the opinion of epicures. Mr. Yarrell observes that the number of species diminishes as the degrees of northern latitude increase: "In this country we have sixteen species; at the parallel of Jutland, Denmark, and the islands at the mouth of the Baltic, there are thirteen; on the coast of Norway they are reduced to ten species; at Iceland the number is but five, and at Greenland only three."

2481.—THE DAB

(*Platessa Limanda*). In the genus Platessa the eyes are on the right side, which is the dark one. There is a row of teeth in each jaw, with others on the pharyngeal bones; branchiostegous rays six.

In our figure, which the artist ought to have reversed on the block, the left side appears as the uppermost or dark coloured; sometimes, indeed, this is really the case, reversed varieties of the flat-fish (whether the right or the left side be normally the dark) often occurring.

The Dab, or Saltie of the Scotch, is common on all the sandy parts of our coast, and is easily to be distinguished from the plaice and flounder, with which it is commonly caught, by the roughness of its scaly upper side, whence the term Limanda, from *lima*, a file. The flesh of this fish is good, and Cuvier says that the dab (la Limande), though small, is more esteemed in Paris than the plaice (la Plie), because it bears carriage better. In the London markets it is very abundant, and also in those of Edinburgh.

The breeding season of this species is in May or June. It is caught both by nets and lines; small fish, mollusks, and minute crustacea constitute its food.

The dab measures on an average from eight to ten inches in length; the lateral line forms an arch over the pectoral fin; the colour of the upper side is of a uniform pale brown; of the under side white.

2482.—THE FLOUNDER

(*Platessa Flesus*). Flook, Fluke, or Fleuke; Mayock Fleuke, Edinburgh; Butt, Yarmouth.

The flounder, though really a sea fish, and extremely common around our coast, where a soft muddy or sandy bed prevails, ascends the rivers, and thrives alike in saline, brackish, or fresh water. It is abundant in the Thames as high as Teddington, and is caught in great numbers, from Deptford to Richmond, by the fishermen, for sale: the mode of fishing for it is by a tuck-net, one end of which is fixed to a grapple, the boat is then sculled by an assistant so as to describe a circle, while the fisherman hands out the net gradually into the water; when the circle is completed, and the space enclosed, the net is hauled in, near the starting-point, the fish extricated, and put into the well of the boat, and the net again cast as before. The flounder will live in fresh-water ponds, though most probably it will not breed there, unless they be of considerable extent, but we are not aware to what degree experiments on this point have been carried. As the flounder lives long out of water, its transportation from place to place is effected with but little difficulty.

We have seen this fish in the Severn; and Colonel Montagu notices it as being found up the Avon, within three miles of Bath. Along our southern coast, and about Margate and Ramsgate, shoals of flounders abound, and also along the shores of the adjacent continent, where other species of flat-fish are very common.

The flounder feeds on small crustacea, worms, insects, and small fishes. Mr. Jesse states that he has seen it pursue minnows with great eagerness in the shallows where the Mole runs into the Thames at Hampton Court. It breeds in February or March. The flounders we commonly see in the fishmongers' shops are of small size; Mr. Yarrell says that some have been known to acquire the weight of four pounds, but such instances are rare. The flesh is agreeable and delicate.

Cuvier observes that reversed individuals (tournés en sens contraire) are very frequent; and Mr. Yarrell says "Varieties of the flounder occur more commonly than those of any other species of flat-fish. I have before me, while now writing, specimens without any colour on either side; specimens with colour on both sides; and specimens with eyes and the whole of the colour on the left side, instead of the right. Those without any colour on either side are albino varieties, through the transparent skins of which of the colour of the blood-vessels and muscles has suggested the names of *rosea* and *carnaria* to the authors who considered them species. The *Pl. passer*, figured by Bloch, pt. ii., pl. 50, is certainly only a reversed flounder having the eyes and colour on the left side—a variety so common, that it is scarcely possible to examine a peck measure of flounders without finding one or more reversed specimens. One of the most remarkable specific distinctions of the flounder, viz., the series of denticulated tubercles placed between the rays of the fins along the dorsal and abdominal lines, is distinctly figured on both Bloch's plates, pl. 44 and 50.

We may here observe that those groups of flat-fish which have as a rule the right side dark, are termed dextral; those which have the left side dark, as the turbot, sinistral.

The flounder is subject to great variations of colour, and those taken from spots where there is a considerable deposit of mud are far darker than those which inhabit sandy places. The flounders for example caught in the backwaters behind Yarmouth, on a bed of mud, are so dark that they are distinguished by the name of Black Butts. Generally, however, the upper side is of an olive grey or brownish olive tint, mottled with irregular dusky spots and marblings; the fins are paler than the body.

The other species of the genus Platessa, peculiar to the shores of our island and the adjacent parts of the continent, are as follows:—the Plaice (Pl. vulgaris), of which a variety distinguished by the clearness of the brown colour above, and the richness of the red spots, is taken off the coast of Sussex, on a particular fishing-station called the Diamond ground; the Lemon Dab or Smooth Dab (Pl. microcephalus), also called Town Dab and Smear Dab, taken along the Sussex coast; the Long Rough Dab (Pl. limandoïdes), a recent addition to our British fishes, and taken occasionally on the Sussex coast; the Pole or Craig Fluke (Pl. Pola), of rare occurrence, and approaching a sole in figure; it would seem to be more common on the coast of France, where, Cuvier says, it is esteemed equal to the sole.

Fig. 2483 represents a fishing-boat on one of the fishing-stations off Hâvre de Grace, with Cape La Hève in the distance.

2484.—THE TURBOT

(*Rhombus maximus*). In this genus the colour and eyes are on the left side; teeth in the jaws and pharynx. In our figures, both of the turbot and brill, the artist has neglected to reverse his drawing so as to bring the fish correct in the impression; consequently they present the right side coloured, instead of the left. Reversed turbots, and also turbots coloured on both sides, are occasionally seen in the markets.

From the time of the ancient Greeks and Romans to the present, the turbot has been celebrated as one of the luxuries of the table, and is often seen of extraordinary weight and dimensions. The ordinary weight of this fish is generally from five to ten pounds, but instances are not unfrequent in which it is found to weigh fifteen or twenty, and even thirty pounds. Mr. Couch, says Mr. Yarrell, "notices in his MS. a record of one taken in 1730, at Cawsand near Plymouth, which weighed seventy pounds. On the 18th of February, 1832, a turbot was caught at Staiths near Whitby, which weighed one hundred and ninety pounds, and measured six feet across. Rondeletius, however, states that he had seen a turbot five cubits in length, four in breadth, and a foot in thickness." It must have been such a turbot which was taken during the reign of Domitian, and which not only puzzled his cooks, but even the senators of Rome, called together by command, in order to devise the best mode of bringing it to table.

The turbot is taken on nearly all the coasts of our island, and is found from Scotland to Cornwall. In Ireland it is principally confined to the south-western coast. Like most other fishes, the turbot has its favourite haunts, where it is found in greater abundance and perfection than in other places. The sandbanks between Dover and the French coast, and those between the English and Dutch coast, which extend in a parallel line to the eastern shores of Great Britain, are the most valuable fishing-grounds. The coast extending from the North Foreland to the Land's-End also abounds with this esteemed fish. On the Flemish banks the finest turbots are taken in abundance by the Dutch fishermen for the London market. The fishing begins towards the end of March, and the fishermen then "assemble a few leagues to the south of Scheveling; as the warm weather comes on, the fish advance to the northward, and during the months of April and May they are found in great shoals on the banks called the Broad Forties. Early in June they have proceeded to the banks which surround the small island of Heligoland, off the mouth of the Elbe, where the fishery continues to the middle of August (the spawning season), when it terminates for that year."

A preference is given in London to the Dutch turbot, which it deserves to some extent. The flesh on the dark-coloured side is considered as the best, and the Dutch turbot are of a darker hue than those obtained on some parts of our own coast; but those taken on the north-eastern coast of England are equal to the Dutch in this respect, while those which the south-western coast produce are lighter. Mr. Barrow says that the Dutch draw about 80,000*l.* a-year for the supply of the London market with turbot; and by Mr. Yarrell it is stated that one-fourth of the whole quantity of turbot brought to Billingsgate is supplied by the Dutch. A large number of turbot are bought at sea of the Dutch fishermen, and brought to London. The French fishermen also sell many at sea to English fishermen. They lay their long lines on the Varne and Ridge, two extensive banks of sand between Dover and the French coast, and often take considerable numbers. When the Dutch fishermen come into our market, they pay for each boat a duty of 6*l.* Each boat brings from one hundred to one hundred and fifty turbots. Bath and Exeter are the two great markets for the sale of turbot caught on the western coast, but even a portion of the supply from this quarter is brought to London by land carriage. The number of turbot sold at Billingsgate market is believed to be about one hundred thousand a-year. Nevertheless these fish always bear a high price; and occasionally, when the supply is small, prices rise to an extravagant height. The fishmongers at the west end of London take off by far the greatest bulk of each day's arrivals.

The Dutch adopt two methods of turbot-fishing: when the fish are on a smooth sandy bottom in shallow water, they use the haul-net, which brings up other kinds of flat-fish, as soles, plaice, &c.; with the turbot; but when the weather becomes warm, and the fish have retired to deeper water, with rough and broken banks at the bottom, they have recourse to long many-hooked lines, baited with smelts, garfish, &c. Formerly the Dutch purchased of the Thames fishermen quantities of the river lampern as a bait, often to the amount of 700*l.* per annum. The silvery colour of this fish, its vitality, and consequent power of enduring mutilation without loss of life, were its great recommendations.

The turbot is indeed a dainty feeder; and though very voracious, it is not every bait that will tempt him; if it be not very fresh, he refuses it, but if bright-coloured and living, it immediately attracts his notice.

According to Mr. Crouch, "The turbot keeps in sandy ground, and is a great wanderer, usually in companies;" and he adds, "though its proper habitation is close to the bottom, it sometimes mounts aloft, and I have known it upon the surface over a depth of thirty fathoms. I have been informed also

of its pursuing to the surface a companion that was drawn up by the line, when both were taken together."

On the English coasts the turbot fishery is carried on both with lines and by trawling. The former is the most general mode pursued on the north-eastern coast, and trawling is practised to a greater extent on the south-western coasts. Mr. Travis, a surgeon who resided at Scarborough, communicated to Mr. Pennant the mode practised by the fishermen of that place. This account will be found in the 'British Zoology,' and is in substance as follows:—Each person is provided with three lines, which are fairly coiled upon a flat oblong piece of wicker-work; the hooks being baited, and placed very regularly in the centre of the coil. Each line is furnished with fourteen score of hooks, at the distance of six feet two inches from each other. The hooks are fastened to the lines upon "sheads" of twisted horsehair, twenty-seven inches in length. When fishing, there are always three men in each coble, and consequently nine of these lines are fastened together, and used as one line, extending in length nearly three miles, and furnished with two thousand five hundred and twenty hooks. An anchor and a buoy are fixed at the first end of the line, and one more of each at the end of each man's lines; in all, four anchors, which are commonly perforated stones, and four buoys made of leather or cork. The line is always laid across the current, and remains upon the ground about six hours, as it can only be shot or hauled at the turn of the tide. The rapidity of the tide on this coast prevents the use of hand-lines; and therefore two of the men commonly wrap themselves in a sail and sleep, while the others keep a sharp look out, for fear of being run down by ships, and to observe the weather. The coble is about one ton burthen, rather more than twenty feet long, extreme breadth five feet, and it is rowed with three pairs of oars. A larger description of boat is also used in the Scarborough turbot fishery. It is forty feet long, fifteen feet broad, and of twenty-five tons' burthen, and is called the "five-men boat," though usually navigated by six men and a boy; but one of the men is hired to cook, and does not share in the profits with the other five. Two cobles are taken on board, and when they reach the fishing-ground they anchor, and proceed to fish in the cobles, and being provided with a double set of lines, they haul one and shoot another every turn of the tide. They generally run into harbour twice a-week to deliver their fish. Such is the account given sixty years ago by Mr. Travis, and it does not appear, from Mr. Yarrell's recent work on British Fishes, that any material change has taken place. The practice varies a little on different parts of the coast, but so it did at the former period.

The turbot is too well known to need minute description; the upper side is tuberculous, with little starlike bones imbedded in the skin. The turbot is called Bannock Fleuk in Scotland. Fig. 2485 represents turbot-fishing off Scarborough.

2486.—The Brill

(*Rhombus vulgaris*). This well known fish is taken in the same localities, and by the same modes of fishing, as the turbot: in the firmness and flavour of its flesh, however, it is very inferior to the latter, though there is a good sale for it in the London markets; numbers are brought from the deep waters and bays of our southern coast, where it is very common, spawning in the month of August. On the Devonshire and Cornish coasts it is termed the Kite, and in some parts of Scotland the Bonnet Fleuk.

Like the turbot, the brill feeds on small fish, crustacea, mollusks, &c., and is equally ravenous; its mouth is large and deeply cleft, and the under jaw is longer than the upper. The weight of the brill seldom exceeds seven or eight pounds, and as it is never known to attain to the dimensions of the turbot, to say nothing of its inferiority as an article of diet, we are somewhat surprised that both Bloch and the writer of the supplement to the class Fishes in Mr. Griffith's edition of Cuvier's 'Animal Kingdom' should say that the enormous flat-fish presented to the Emperor Domitian was a brill. No reasons are given, nor is any authority quoted.

The brill is more oval than the turbot, and the skin is destitute of tubercles, its surface being perfectly smooth.

2487.—The Sole

(*Solea vulgaris*). In the genus Solea both the eyes and colour are on the right side (the figure in this respect is erroneous); there are small teeth in both jaws, but confined to the under side only, none being on the same side as the eyes. The form of the body is oblong. This well known and excellent fish is found all round our coasts where the bed of the sea is sandy, its range extending northwards to the Baltic and southwards to the Mediterranean. The principal fisheries of the sole for the London markets are along the southern coast of England, and as the fish seldom takes the bait, trawling-nets are used, by means of which enormous quantities are captured: they are sent to market packed up in baskets, and in the course of twelve months Billingsgate has received eighty-six thousand bushels of soles.

The sole is in season throughout the greatest portion of the year, and is full of roe in February. In March or April it spawns, and is then for a few weeks soft and flabby, but soon recovers. Its food consists of small shelled mollusks, and the spawn and fry of other fishes. The flesh of the sole is firm, white, and of excellent flavour; were it indeed a rare fish, instead of being abundant, it would command a high price in the market: as it is, this delicacy finds its way to the tables of all classes.

Mr. Yarrell records a pair of soles taken in Torbay which measured each in length twenty-three inches, and weighed together ten pounds; and he adds, "For the particulars of the largest I have heard of, I am indebted to the Rev. W. F. Cornish of Totness. This specimen, a remarkably fine-grown fish, and very thick, was twenty-six inches long, eleven inches and a half wide, and weighed nine pounds.—Totness market, June 21, 1826."

Though the sole is a sea fish, it thrives well in fresh water, to which indeed it may be transferred without difficulty. Dr. MacCulloch, in his papers in the Royal Institution Quarterly Journal, 1825, on changing the residence of certain fishes from salt to fresh water, instances a sole that for many years was kept in a pond of fresh water in a garden. In Mr. Arnold's pond at Guernsey soles live at their ease and improve, becoming twice as thick for their length as those taken out of the sea. The following interesting letter from a gentleman residing on the banks of the Arun contains an important statement:—

"I succeeded yesterday in seeing the person who caught the soles about which you inquire, and who has been in the constant habit of trawling for them with a ten-feet-beam trawl in this river (the Arun) for the last forty years. The season for taking them is from May to November: they breed in the river, frequenting it from its mouth, five miles upwards, which is nearly to the town of Arundel, and remain in it the whole year, burying themselves in the sand during the cold months. The fisherman has occasionally taken them of large size, two pounds weight each, but frequently of one pound, and they are thicker in proportion than the soles usually caught at sea; in other respects precisely the same; and it is evident they breed in great numbers in the river, from the quantity of small ones, about two inches long, that are constantly brought ashore when drawing the net for grey mullet."

Reversed soles, that is, with the left side dark coloured and the eyes sinistral, are not uncommon. Mr. Yarrell informs us that he has a curious specimen that is of the usual dark colour, with rough ciliated scales, on both sides alike.

We owe the recognizance of a distinct species of British sole, the Lemon Sole (Solea Pegusa), to that excellent naturalist Mr. Yarrell, who obtained a specimen at Brighton, in February, 1829. Since that time two or three other specimens have been obtained in the London market; those which were presented by Mr. Yarrell to the Museum of the Zool. Society we have often examined.

Mr. Yarrell states that "this sole is occasionally taken with the common sole when trawling over a clear bottom of soft sand, about sixteen miles from Brighton, in a direction towards the coast of France, from which circumstance this fish is known to some of our fishermen by the name of French sole; others call it by that of lemon sole, in reference to its prevailing yellowish colour. In shape the lemon sole is wider in proportion to its length than the common sole; it is also somewhat thicker, and the head is smaller. The prevailing colour is a mixture of orange and light brown, speckled over with numerous small round spots of dark nutmeg brown, giving a mottled appearance to the whole upper surface." The scales differ in character, and the tail is narrower than in the ordinary species; the under surface of the head is almost smooth, without any of those papillary eminences so numerous and remarkable in the common sole; and the nostril is pierced in a prominent tubular projection, which is wanting in the other; the scales, moreover, of the under surface are more strongly marked than those of the upper.

Another rare sole, the Variegated Sole (Monochirus linguatulus, Cuv.), is also occasionally taken off our shores.

2488.—The Marbled Sole

(*Achirus marmoratus*). The genus Achirus differs from Solea in the absence of pectoral fins.

This genus, says Cuvier, may be separated into two subgenera, the first of which (Achirus, properly so called) has the vertical fins distinct; the second (Plagusia) has them united to the caudal.

The marbled sole (Achirus) is of a bluish white colour, sprinkled with innumerable small black spots; the body is covered with very diminutive scales, and the flesh is of a very delicate flavour and highly esteemed. This species is a native of the coasts of the Isle of France. Commerson informs us that a small pore is seated at the base of each of the rays of the fins of this species, from which issues, upon pressure, a milky fluid of the consistence of olive oil. Most probably this is a lubricatory fluid for protecting the scales. All the soles are, in fact, remarkable for the adhesive slime or glaze which covers them, and which to the practised eye indicates the freshest fish, the most recently drawn from the sea, of those which the fishmonger's shop offers for choice.

Fig. 2489 represents the fishing-boats on the beach at Hastings.

Fig. 2490 is a sketch of a fish-boat trawling for red mullet off St. Alban's Head, Dorsetshire.

St. Aldhelm's, commonly called St. Alban's Head, is a well-known landmark on the Dorsetshire coast. It does not stretch out so far into the sea as the opposite promontory of Portland Bill; but a line drawn from one point to the other, and which would be above twenty miles in extent, would comprise a large expanse of ocean, in which are to be found good roads for shipping, safe harbours, and secure coves for smaller vessels. The cliff, which presents its rugged form seaward, rises almost perpendicularly to a height of four hundred and forty-one feet. On this promontory a chapel was dedicated to St. Aldhelm, the first bishop of Sherborne. It was vaulted with stone, and sustained by a single massive pillar. The only means for the admission of light was by the door. It was an oratory rather than a chapel, in which, according to Hutchins, the historian of Dorsetshire, masses were said, and prayers uttered for the passing mariner, who left some recognition of his gratitude at the next port at which he touched, to be applied to the maintenance of the priest. In the beginning of the present century the building was nearly in ruins.

Order MALACOPTERYGII, *continued*.

APODES.

This group derives the name apodal, or footless, from the absence of ventral fins.

Family MURÆNIDÆ (EELS, CONGERS, &c.)

The Murænidæ, or Eels, are fishes of an elongated slender form, with a soft thick skin, without perceptible scales, and very slimy. The gill orifices are very small and surrounded concentrically with rays, and are carried far back, so that a sort of passage is formed leading to the branchiæ, which are thus the better sheltered, so that the fish is capable of living for a considerable time out of water without perishing.

The air-bladder is generally present. Though there appear to be no scales, yet very minute scales really exist, imbedded as it were in the thick fatty skin, but they cannot well be seen until the skin is dry.

Fig. 2491 is a characteristic representative of the Head of the Eel.

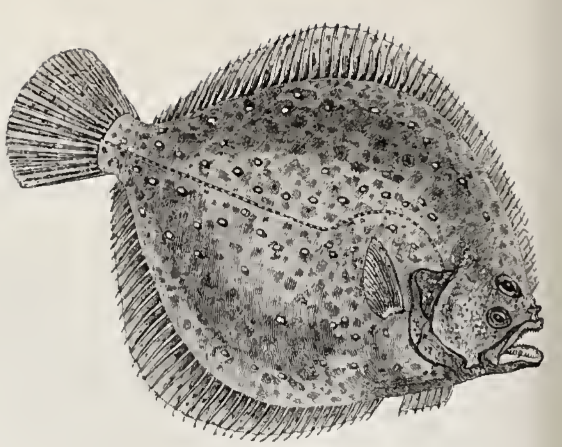
2492.—The Sharp-nosed Eel

(*Anguilla acutirostris*, Yarrell). In the genus Anguilla the body is elongated, and cylindrical, becoming more and more compressed to the tail; the mucous glands of the skin are large; the air-bladder is long: there are teeth in each jaw, and a few on the vomer. The pectoral fins are close to the small branchial aperture. There are no ventral fins, and the dorsal fins, the caudal fin, and the posterior below are all united.

Cuvier in his last edition of the 'Règne Animal,' in reference to the true eels (Anguilles vraies) says, "Our fishermen recognise four kinds, which they regard as forming so many species, but which authors confound under the general term of *Muræna Anguilla*, Linnæus, viz.: the 'Anguille verniaux,' which is, I believe, the most common; the 'Anguille long-bec,' of which the muzzle is more compressed and pointed; the 'Anguille plat-bec,' Grig-eel of the English, which has the muzzle more flattened and obtuse, and the eye smaller; and the 'Anguille pimperneaux,' Glut-eel of the English, which has the muzzle shorter in proportion, and eyes larger than those of the others."

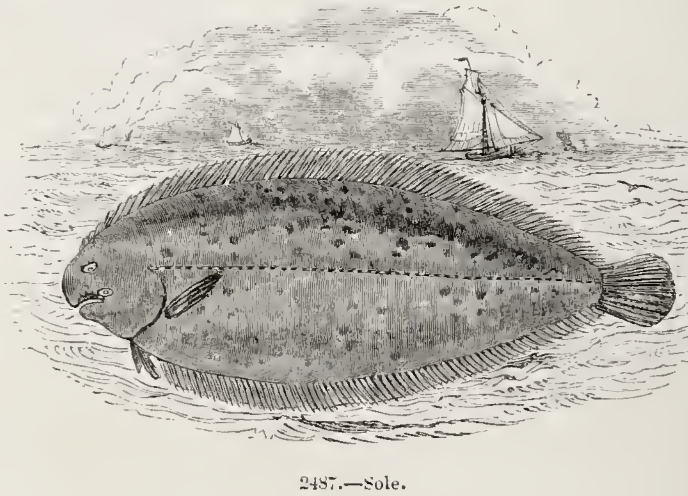
Mr. Yarrell, in his work on Fishes, distinguishes the following species as indigenous in the British Islands:—The Sharp-nosed Eel (A. acutirostris), Long-bec of Cuvier; the Broad-nosed Eel (A. latirostris); Glut-Eel, Bowdich (Pimpernaux, Cuvier); the Snig (A. mediorostris). Besides these he introduces the figure of a fourth eel, with the following observation: "The term Grig in and about London

2489.—Fishing-boats at Hastings.

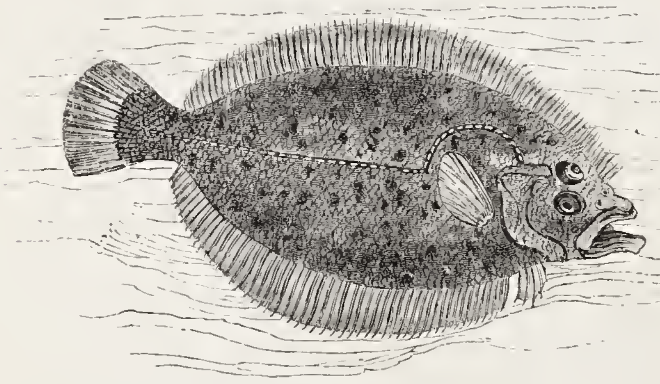


2484.—Turbot.

2488.—Marbled Sole.



2487.—Sole.



2486.—Brill.

2485.—Turbot-fishing off Scarborough.

2490.—Trawling for Red Mullet off St. Alban's Head.

2495.—Deep-nosed Pipe-fish.

2491.—Head of Eel.

2496.—Short Sun-fish.

2493.—Thames at Eton.

2492.—Sharp-nosed Eel.

2494.—Thames Trout in basket.

2497.—Beluga Sturgeon.

is applied to a particular eel of small size, of which the figure here introduced represents the head. This eel is the Anguille plat-bec of Cuvier, 'Règne An.,' tom. ii. p. 349, who considers it as a distinct species. It is the Grig-eel also of Mrs. Bowdich's 'British Freshwater Fishes,' No. 28, in which work the three eels already spoken of here are well figured; and the species were considered by Cuvier as identical with those of the 'Règne Animal.'"

If, then, this last be distinct from A. latirostris, we have four species of eels in the waters of our islands, and the same occur in those of France. With respect to the term Grig we may observe, that in most parts of England it is merely applied to any small eel, when not above nine or ten inches long, and of which from eight to ten are required to make up a pound weight.

In their habits and manners these eels are very similar, and their flesh equally excellent. Eels inhabit ponds, rivers, and the brackish water at the mouths of rivers: and further, they may be regarded as migratory fishes: in the autumn they make their way to the sea, in vast numbers, as it is believed, for the purpose of depositing their spawn; whether they ever return up the river again, is not very clear, but in spring myriads of minute eels not above three or four inches in length make their way from the brackish water, up the rivers, which they ascend, dispersing themselves as they proceed. These migrations have been observed in various rivers, as the Thames, Severn, Dee, &c. Some writers consider that the parent eels, as well as their countless fry, return from the brackish water of the estuary, and regain their haunts in the river.

"In a tideway river," says Mr. Yarrell, "the descent of eels towards the brackish water takes place during the autumn, and various devices are employed in different streams to intercept them in their progress." Among these are frames of wood supporting wicker baskets or traps, which form very picturesque objects, and are common at various places along the Thames; yet it is very clear that all the adult eels in tidal rivers do not descend to the estuary, for it is well known that thousands lie buried in the mud to the depth of twelve or sixteen inches, in a state of torpidity, and quantities are often taken in this condition by means of eel-spears. In Somersetshire, says Mr. Yarrell, "the people know how to find the holes in the banks of rivers, in which eels are laid up, by the hoar-frost not lying over them, as it does elsewhere, and dig them out in heaps. The practice of searching for eels in cold weather is not confined to this country. Dr. Mitchell in his paper 'On the Fishes of New York,' published in the 'Transactions' of the Literary and Philosophical Society of that city, says, "In the winter eels lie concealed in the mud, and are taken in great numbers by spears." The torpidity of the eel is connected with a low degree of respiration; and, as Dr. Marshall Hall has shown, with this low grade of respiration co-exists great muscular irritability, a low temperature, and great tenacity of life, together with the power of long sustaining the privation of air and food. These peculiarities are characteristic of these fishes, and, as Mr. Yarrell observes, the muscular irritability of eels accounts for their restless motions and agitation during thunder storms, at which time hundreds, roused from their haunts, rush tumultuously, and are captured in various traps, which imprison all that enter. He adds also, that their power of enduring a low temperature is shown by the fact that eels exposed on the ground till frozen, then buried in the snow, and at the end of four days put into water, and so thawed, slowly discover signs of life, and soon perfectly recover. Now this power of bearing cold is at singular variance with the opinion that they are averse to a low temperature, and consequently that none exist in the rivers of Siberia, the Wolga, the Danube, or any of its tributary streams; nay, more, that they are killed by cold or frost. Mr. Thompson, in 'Ann. and Mag. of Nat. Hist.,' March, 1841, says, "On the 6th, 7th, and 8th of the present month, February, 1841, great quantities of this fish in a dead state floated down the river Lagan to the quays at Belfast. Here, upon these days, and along the coast of the river within the tideway, collecting dead eels was quite an occupation at low water. Three examples sent me by my friend Edmund Getty, Esq., were the Common Eel (A. acutirostris, Yarr.). They were found dead, of all sizes, up to the largest." It appears that a piercing east wind, accompanied by a hard frost, prevailed; and as at low water a great extent of mud-banks is uncovered, the eels there imbedded are supposed to have perished from the intense cold arising from the rapid evaporation occasioned by the bitter gale. In January, 1814, great quantities of eels in the same river met with a similar fate, an east wind prevailing, with an intense frost. In 1841, during the month of March, at the same time that the eels perished in the Lagan, multitudes of congers, varying from a foot to five or six feet in length, perished in the river Lee, about six miles below Cork. (See Mr. F. Jennings' report, in the 'Ann. and Mag. of Nat. Hist.,' May, 1841.) We believe that other instances of a like nature are on record.

With respect to the assertion that there are no eels in the Danube, it is not quite correct; there are none in the Lower Danube. Captain Widdrington, R.N., says, "During a recent tour in Germany, I was surprised to see eels put upon the table at Wurtzburg, which is high up the Mayn, and in a very cold country during winter; I was subsequently informed that they are abundant at Hanau, lower down the same river, the waters of which must be at least as cold as those of the Danube. On arriving at Vienna, I mentioned the circumstance to Professor Heckel, who has the charge of the ichthyological department, who informed me that great numbers were brought to Vienna from Ulm, which is high up the river (Danube), but that they have never been seen lower down. Subsequent inquiry, and having ascertained the very great pains which have been taken in investigating the natural history of the river, satisfied me that this account was true; and that it is next to impossible they should not have been detected had they frequented the Lower Danube. The fish-market at Vienna is held on the river, the well-boats being moored to the shore, whence the inhabitants of that luxurious capital are supplied with the most delicious fish brought from all sides. These people informed me that they drew part of their supplies of eels from Ulm, but that the greater part came from Bohemia, consequently from the head-waters of the Elbe, which ought to be a still colder river than either the Rhine or Danube. This winter the thermometer was 19° at Vienna, whilst at Dresden I was told it fell to 24° Reaumur.

"Now, assuming the case as I have stated, that the habitat of the genus is confined to the upper streams of the Danube, we have the fact that migration is not necessary to them, though it is certainly their habit in this country. It must be remembered that Ulm is in a very cold country, being considerably higher than Vienna. There can be little doubt that the eels there hybernate in the mud, but why do they not remove to the more genial region, and to the admirable locality of the delta of that great river? The reason I take to be the following—the waters of the Danube may be divided into three classes; first those of the Black Forest and that vicinity and those which fall into the river from the left towards Bohemia. These waters are more or less rich and fat, and of the description which affords the most abundant nutriment to fish, especially of the genus under consideration. Below Ulm, however, a change soon becomes visible: the great tributaries from the Alps begin to pour in, and soon alter the character of the water. These Alpine streams may be divided into two classes;—those which proceed at once from the glaciers and upper valleys without meeting with large lakes to filter and purify them, like the Rhine and Rhone; these waters are charged with the comminuted particles of the rocks over which they have passed, and are not only rapid, but have a peculiar strength and rawness, which, I consider, combined with the want of food, renders them uninhabitable by the eel and many other sorts of fish; even the trout are scarce and of bad quality, and the only good trout in the Alps are those from the lakes or the streams of the plains, where better nourishment is afforded to them. The second class of Alpine waters are those which have passed through and been purified by the lakes, from which they issue clear, softer, and warmer than those we have mentioned. Even these rivers are not favourable to the propagation of fish in general, and I was surprised to find that in the country so eloquently described by Sir H. Davy, and which I expected to find teeming with fish, that it was scarce and dear, though full of the most beautiful lakes and rivers." ('Ann. and Mag. of Nat. Hist.,' Nov., 1841.)

It is, then, according to these views, from the vast influx of Alpine water, as the Inn, the Traun, the Save, and Drave, that the Lower Danube is unfitted for this fish, and not from the mere coldness of the river. In our own country it may be observed that few or no eels inhabit mountain streams and rivers.

That eels breed in the fresh water of inland rivers and lakes, from which they are unable to visit the sea, is a point on which little doubt exists; indeed, Mr. Yarrell expressly states, that in the Mole, the Wey, and the Longford river, and in various large ponds, from which there is no possible egress, the eel does not deposit its spawn till near the end of April, while in eels from the brackish water of higher temperature the breeding season takes place much earlier.

Eels often quit the water, and wander during warm dewy nights on the grass, either in quest of worms, frogs, and other food, or in order to change their locality; hence they often travel from rivers into adjacent ponds, where the fry of other fishes are thinned by their rapacity. On one occasion we ourselves saw three or four eels on the banks of the Severn, near Bewdley: it was dusk, the weather was warm, and the grass wet with dew; several small pools close by seemed at the same time alive with eels.

The passage of the shoals of young eels up the Thames in spring, which is continued for several days, is called *Eelfare*, the Saxon word *fare* signifying to travel (as in wayfare, seafaring, thoroughfare), and Mr. Yarrell thinks that the term *Elver*, applied along the Severn to a young eel, is a corruption of *Eelfare*. The London market is principally supplied with eels from Holland by Dutch fishermen. The vessels are built with capacious wells for their preservation alive, and each brings a cargo of fifteen or twenty thousand pounds' weight of live eels, for which the Dutch merchant pays a duty of 13*l.* per cargo for permission to sell.

The eel is among the fishes of the South Sea Islands. Ellis, in his 'Polynesian Researches,' vol. ii. p. 286, says:—"In Otaheite eels are great favourites, and are tamed and fed until they attain an enormous size. These pets are kept in large holes, two or three feet deep, partially filled with water. On the sides of these pits they generally remained, excepting when called by the person who fed them. I have been several times with the young chief, when he has sat down by the side of the hole, and by giving a shrill sort of whistle has brought out an enormous eel, which has moved about the surface of the water, and eaten with confidence out of its master's hand."

Fig. 2493 represents a view of the Thames at Eton; in the whole of this part of the river, from Hampton up to Reading, and beyond, this fish is very abundant. Fig. 2494 represents a fish-basket, better adapted for large fish than those in common use. It contains a fine Thames Trout.

SECTION LOPHOBRANCHII.

The fishes of this group are distinguished by having the branchiæ, or gills, divided into little tufts of a rounded form, disposed in pairs along the branchial arcs, instead of exhibiting a pectinated structure as in the previous fishes. They are concealed under a large operculum or flap attached around its margin by means of a membrane, leaving only a small aperture for the exit of the water, and exhibiting in its structure merely slight traces of rays. The fish of this group, besides, have the body cuirassed from one extremity to the other by scutcheons, which render it angular. The swimming-bladder is of tolerable size, but of thin tissue.

Family SYNGNATHIDÆ (PIPE-FISHES).

2495.—The Deep-nosed Pipe-fish

(*Syngnathus Typhle*). In the genus Syngnathus the body is elongated, slender, cuirassed with plates in parallel lines; the head is long, the jaws are produced, united, and tubular; there are no ventral fins. In two species, the great pipe-fish and the deep-nosed pipe-fish, the males have an elongated pouch under the tail, closed by two folding membranes. These two fishes (which have dorsal, pectoral, and caudal fins, and a posterior one below, while the other species have only a dorsal fin) are common on many parts of our coast, sometimes appearing among sea-weed in low water, at other times seeking the deep water: they "move slowly about in a singular manner, horizontally or perpendicularly, with the heads downwards or upwards, and in every attitude of contortion, in seach of food, which chiefly seems to be water-insects."

One portion of their history is very remarkable: the male receives the roe of the female in the subcaudal pouch referred to, and here the eggs, which are large and yellow, lie in hemispherical depressions until hatched, when the young make their escape. But at what time or in what manner the eggs are transferred to this receptacle appears to be not as yet ascertained. Mr. Yarrell observes, "M. Risso notices the great attachment of the adult pipe-fish to their young; and this pouch probably serves as a place of shelter to which the young ones retreat in case of danger. I have been assured by fishermen that if the young were shaken out of the pouch into the water over the side of the boat, they did not swim away, but when the parent fish was held in the water in a favourable position, the young would again enter the pouch." The mouth in these fishes is small, placed at the extremity of the tubular snout, and opening obliquely upwards. In the deep-nosed pipe-fish the tube is much deeper than in the great pipe-fish, and more compressed at the sides.

To the present family belong those extraordinary fishes, the Hippocampi.

SECTION PLECTOGNATHI.

In the imperfect structure of their jaws, and the slow ossification of the skeleton, these fish approach the cartilaginous series. Their principal character consists in the solid attachment of the maxillary bone on the side of the intermaxillary, which forms alone the jaw; the palatal bones unite with the skull by means of a suture, and consequently are destitute of mobility. The gill-flaps and rays are concealed under a thick skin, which gives exit to the water only through a small orifice. There are only trifling vestiges of ribs; ventral fins are wanting; the swimming-bladder is generally considerable.

Family GYMNODONTIDÆ (GLOBE-FISHES, SUN-FISHES, DIODONS, &c.).

The jaws, instead of being furnished with ordinary teeth, are garnished with an ivory substance, divided into series of laminæ, the whole resembling a parrot's beak; this beak really consists of true teeth united together, succeeding each other, in proportion as the anterior teeth or laminæ are worn by trituration. These fishes live on crustacea and sea-weed, and their flesh is generally musky, and even unwholesome. Some, as the tetraodons and diodons, are capable of inflating themselves into a spherical form, and thus distended they float with the back downwards, and make progress by the aid of the pectoral fins. The sun-fishes seem capable of floating, but not of distending themselves with air.

2496.—THE SHORT SUN-FISH

(*Orthagoriscus mola*). In these flat discoid fishes the dorsal and posterior fin below are united to a deep caudal fin, of which they seem to be two long wing-like points. The short sun-fish is sometimes seen floating in our seas, with little motion, appearing, as it lies on one side, like a fish dead or dying. It attains to a great size, upwards of four feet in length, and more than three hundred pounds in weight. Mr. Neill says, respecting one brought to him,—"The fisherman informed him that when they observed it, it was swimming along sideways, with its back fin frequently above water; it seemed to be a stupid dull fish, and made little or no attempt to escape, but allowed one of the sailors to put his hands under it and lift it fairly into the boat. The sun-fish is generally mentioned as remarkable for its phosphorescence; but this specimen did not exhibit that phenomenon so distinctly as a haddock or herring."

The sun-fish, according to Mr. Couch, is migratory, and, he suspects, keeps at the bottom feeding on sea-weed; but in calm weather it mounts to the surface, and lies, perhaps asleep, with its head and even its eyes above the water, floating with the tide. Mr. Couch has known the sun-fish make powerful but awkward efforts to escape when attacked, bending and directing its motions in various ways. (See Yarrell.)

CHONDROPTERYGII (CARTILAGINOUS FISHES).

In these fishes with a cartilaginous skeleton, the maxillary and intermaxillary bones are reduced to a mere rudiment, and their functions are filled by bones analogous to the palatal, and even sometimes by the vomer. They are divided into two sections: those with the branchiæ free, covered with gill-flaps; and those with the branchiæ fixed by their outer edge, the water escaping by five or more branchial apertures pierced in the skin. To the first division belongs the Sturgeon; to the second, the Sharks and Rays.

Family STURIONIDÆ (STURGEONS).

2497.—THE BELUGA STURGEON

(*Acipenser huso*). In the genus Acipenser the body is elongated and angular, defended by indurated plates and spines arranged in longitudinal rows; snout pointed and conical; mouth placed on the under surface of the head, tubular, and without teeth.

The species of the genus Acipenser are very numerous; seven species appear up the Danube, different from the ordinary sturgeon (A. Sturio), which is caught, often of large size (from six to eight feet and upwards in length, and two or three hundred pounds in weight), around our coast and in our estuaries. Along the northern coasts of Europe the common sturgeon is very abundant, and extensive fisheries are established for its destruction. Caviar is made from the roe of the female; isinglass from the thick air-bladder; and the flesh, besides being highly esteemed while fresh for the table, is preserved by salting and pickling.

In the Caspian Sea there is a huge species, called Le Hausen, Great Sturgeon, and by some Beluga* Sturgeon, which often measures fifteen and sometimes twenty feet in length, and individuals weighing from one thousand to fifteen hundred pounds' weight are not unfrequently taken. An extensive fishery is established for the purpose of capturing these fish for the sake of the roe and the air-bladder, and as many as 103,500 are said to be taken in the course of a year, affording 30,000 pounds of isinglass, and 414,000 pounds of caviar. The fishery is kept up during the winter, holes being made in the ice for the introduction of the ropes and lines. The principal fishing, however, commences about the end of March or beginning of April, when the great sturgeons approach the shore in immense swarms; they are caught by means of lines, each about nine feet long, with a baited hook, and fastened to the number of 125 to a rope 262 feet in length.

This rope, with its lines, is called a nest, and thirty of these nests tied together commonly belong to one fishing-machine; the two ends of this are secured to two wooden anchors, and a stone of several pounds weight divides each nest. The rope, stretched out from point to point, floats heavily in the water, and is visited twice a day, and the lines tried; the fish attached to the hooks are secured by a cord passed through their gills, and drawn ashore. This work lasts about a fortnight, when, on the retreat of the great sturgeons to the deep water, a smaller species takes their place; it is termed the Sevruga (A. helops, Pall.), and seldom exceeds four feet, but sometimes attains to eight or ten, and is so numerous, that a single vessel will in the course of a fortnight capture 16,000 or 20,000.

In the autumn there is a second fishery of the great sturgeon, and, as we have said, it is kept up on the ice during the winter. The value of the different sorts of sturgeons and their products, caught in the Caspian in an ordinary year, is said to amount to 300,000*l*. Of the skins of old and large fish a sort of leather is made, and those of the young are used in some parts of Russia and Tartary instead of window-glass. But we must pass to our second division.

Family SQUALIDÆ (SHARKS, DOG-FISH, &c.).

2498.—THE SMALL-SPOTTED DOG-FISH

(*Scyllium Canicula*). In a sketch like the present want of space precludes our entering into all the structural details of the present family, or into the grounds upon which the many genera are founded. For daring, voracity, and rapidity, these fishes have been long notorious.

Of the sharks which frequent our seas the small-spotted dog-fish is one of the most common, and few have visited the shore who have not observed its flat oblong eggs with a long tendril from each corner, called sea-purses, thrown upon the beach, or clinging to the ponds of sea-weed. It may be here observed that many of the true sharks are ovoviviparous, producing their young alive, while others produce eggs in the form of horny cases, with two fissures, one at each end, for the admission of sea-water, and the exit of the young.

Among the sharks the females exceed the males in size; they hunt in company, are very tenacious of life, and their teeth are severe weapons, formed for cutting and retaining their prey.

On our southern coast especially the present species (of small size) is very abundant, and annoying to the fishermen, who often capture it in their nets, and draw up a useless booty; it is, moreover, injurious to the interests of the fishermen from its voracity, making terrible havoc amongst the shoals which migrate towards the coast. The same observation applies to the other species of dogfish and sharks which frequent our seas.

Of these the following are described by Mr. Yarrell:—The Large-spotted Dog-fish (Scyllium catulus), le Rochier of the French; the Black-mouthed Dog-fish (Scyllium melanostomum), rare on our coast, but well known in the Mediterranean; the White Shark (Carcharias vulgaris), le Requin of the French, a large and dangerous fish, occasionally met with on the British coast, more common in the Mediterranean, and the dread of mariners in the seas of warmer latitudes, where it will follow the vessel for leagues, and is often taken by a baited hook. The Fox-Shark, or Thresher (Carcharias vulpes), remarkable for the length of the upper portion of the tail-fin; it measures from eight or ten to fifteen feet in length, and has received the name of Thresher from its mode of defending itself by violently lashing with its powerful tail. It is not common near our shores, but is frequent in the Mediterranean and the warmer seas. The Blue Shark (Carcharias glaucus), a migratory visitor to the coast of Cornwall, arriving about the middle or latter part of June, and detested by the fishermen for the devastation it commits among the shoals of pilchards, &c., and the injury it does to the nets, which it cuts to pieces with its teeth as an easy means of extricating the fish entangled in the meshes, swallowing both fish and string together. The Porbeagle (Lamna Cornubica), a species more common on the north and north-east coast of our island, especially in autumn, than along our southern shores. It appears to be gregarious, hunting its prey in small troops. The Beaumaris Shark (Lamna Monensis), rare on our shores, two specimens only having been taken on the Anglesea side of the Menai. The Tope or Penny Dog (Galeus vulgaris), a common species on the southern coast and along the shores of Cornwall, attaining to six feet in length, and noted for its rapacity. The Smooth Hound (Mustelus lævis), a species in tolerable abundance round our coast, and used in the Hebrides as food. It is l'Emissole of the French. Its food consists of crustacea, which its flat teeth, arranged like the pieces of a mosaic pavement, are well adapted for crushing. The Basking Shark (Selachus maximus), so called from its habit of basking quietly on the surface of the sea in sunny weather, when it is so listless as often to allow of the close approach of a boat: it is seen principally off our southern coast, and one measuring thirty-six feet in length was taken some years since near Brighton. The Picked Dog-fish (Spinax Acanthias), a common species, with a sharp spine before each dorsal fin, used as effective weapons of defence. It is very annoying to fishermen, and is gregarious in its habits. The Greenland Shark (Seymnus borealis), a native of the northern seas, but occasionally visiting the shores of Scotland. It measures from ten to fifteen feet in length, and is celebrated as being one of the deadly foes of the whale.

* The true Beluga is a species of porpoise or dolphin (D. leucas, Gm.), in the northern seas.

Family RAIIDÆ (RAYS AND SKATE).

2499.—THE THORNBACK

(*Raia clavata*). The Rays or Skate are of a depressed figure having the disc rhomboidal, the great breadth of the body being produced by the singular expansion of the pectoral fins. There is no distinct head; the tail is long and slender, and furnished with two dorsal or upper fins, and sometimes with the vestige of a caudal. The mouth and branchial orifices are on the under surface. The texture of the skin varies; in some it is rasp-like, in others studded with tubercles or spines, with which latter the tail is always armed. These fishes, some of which attain to enormous dimensions, are admirably adapted by their form for existing at the bottom of the water on beds of sand or mud. When disturbed they slide along in an undulatory manner, and with a slight motion of the pectoral fins. They defend themselves by lashing violently with the tail. The Rays are very voracious, feeding on fishes and crustacea, together with shelled or naked mollusks. Their teeth are flattened and lozenge-shaped, and set in close array; but in adult males the posterior angles of the teeth become elongated (at least in most species), forming a serried phalanx of points directed backwards. So powerful are the jaws, that they are capable of crushing the shell of a crab with the greatest ease. At the base of each ventral fin posteriorly and beneath is a cylindrical appendage, peculiar only to the male. The females exceed the males in size; their eggs are corneous, and closely resemble those of the dogfish.

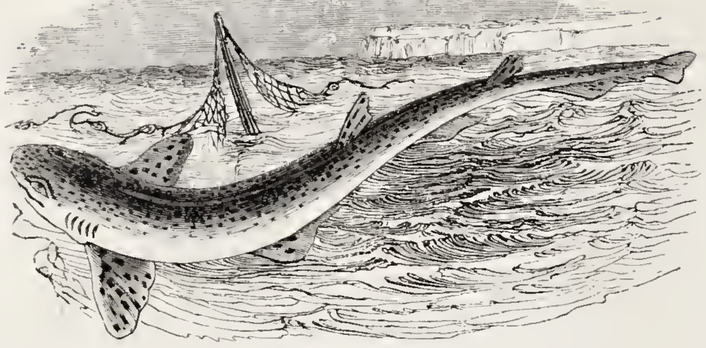
The thornback is very common on our coasts, and is taken in abundance for the table in spring and summer, when it visits the shallows. Its flesh, however, is in the best condition in November. The female is known under the term of "Maid." The skin is covered with thorny tubercles, variable in number.

Fig. 2500 represents a fisherman of South Wales with his coracle, or portable boat of hide or pitched canvas stretched over slight ribs of wood. In this frail bark he fearlessly ventures on the waters of the Severn or the Wye: such were the boats of the painted Britons in the time of Cæsar.

Fig. 2501 represents ancient Egyptians capturing fish with a drag-net. Fig. 2502, Egyptians angling. Both are taken from a tomb at Beni-Hassan: they illustrate the mode in which fish were taken in the Nile at a remote period.

Fig. 2503, 2504, 2505, are delineations of Arab fishermen of the present day.

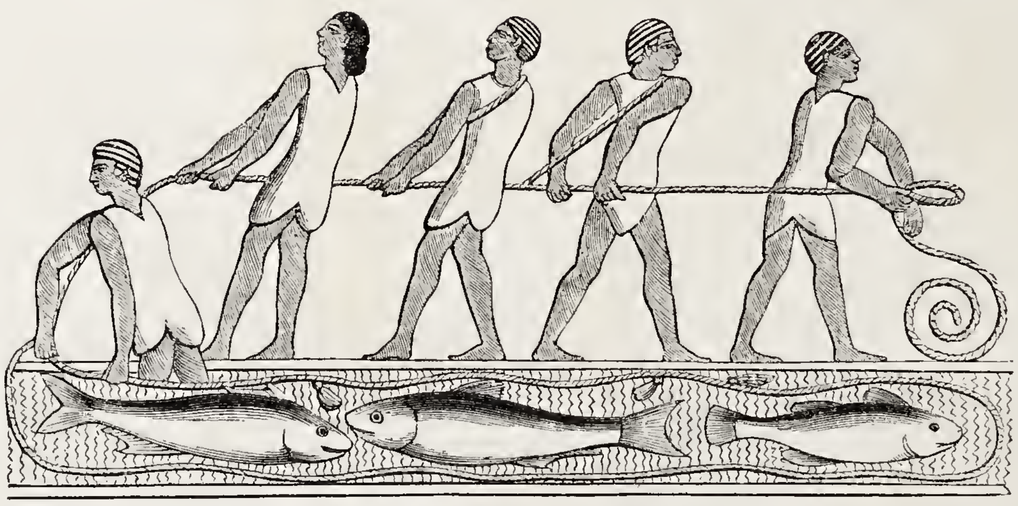
END OF THE CLASS PISCES (FISHES).


2498.—Small-spotted Dog-fish.


2499.—Thornback.


2504.—Arab Fishermen.

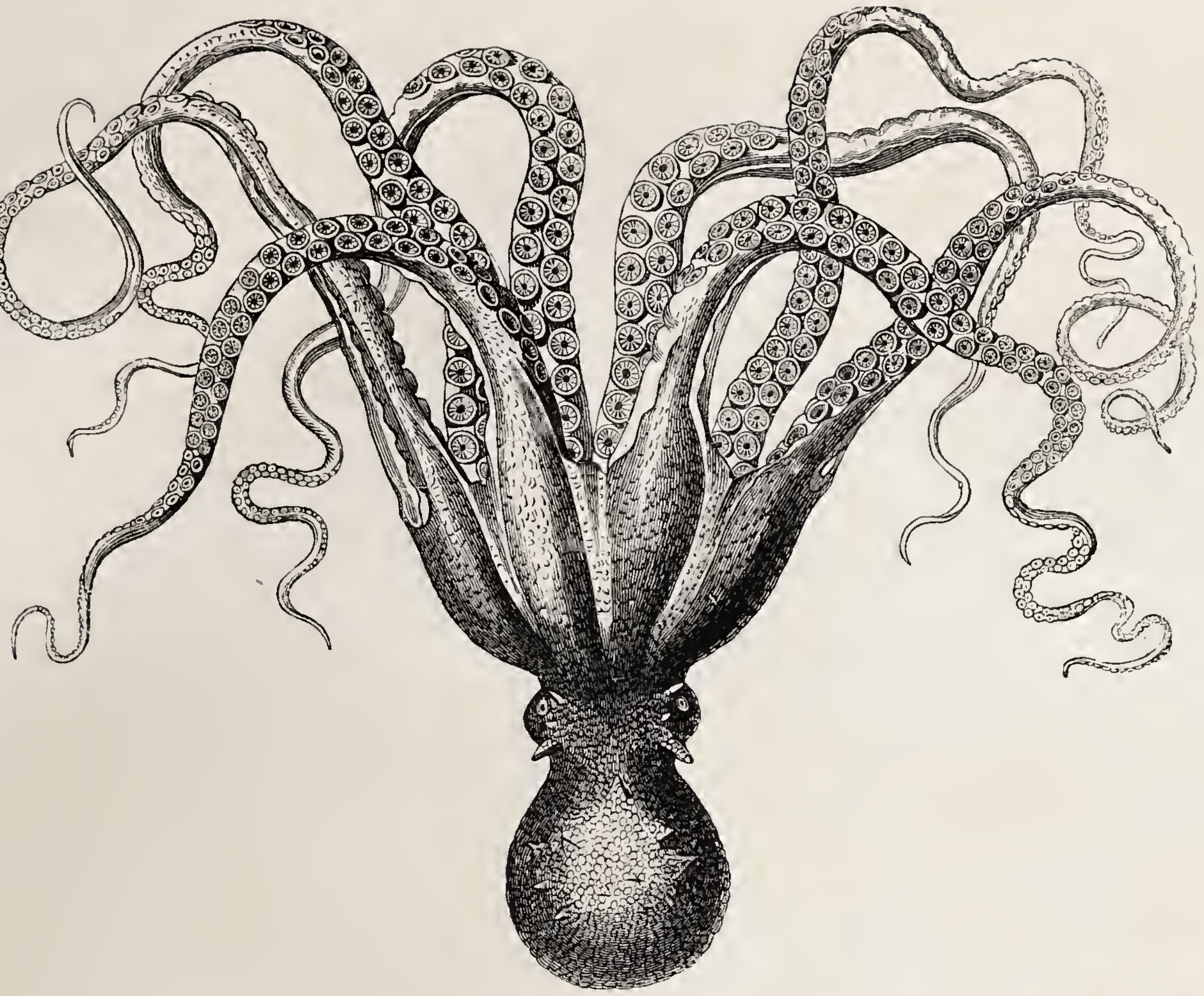

2505.—Arab Fisherman.


2501.—Ancient Egyptians fishing with drag-net.


2500.—Fisherman of South Wales, with Coracle.


2502.—Ancient Egyptians angling.

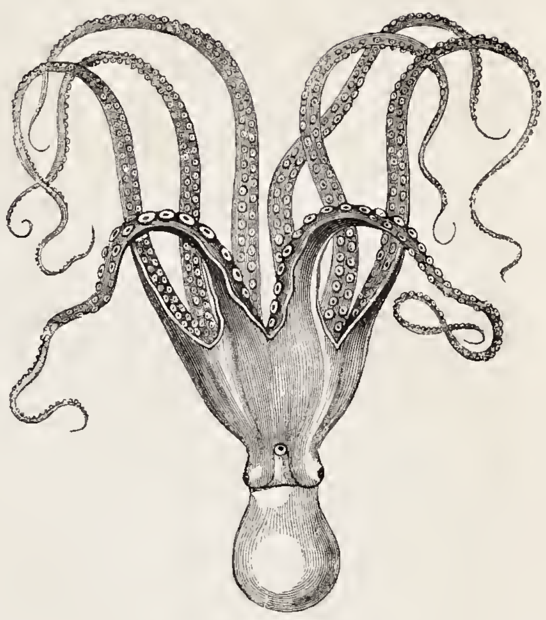

2503.—Arab Fisherman.



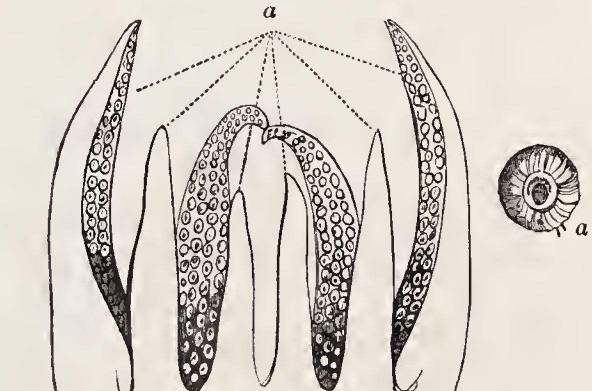
2506.—Common Cuttle-fish.

2513.—Arctic Rossia.

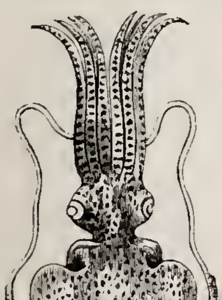
2509.—Ventricose Cuttle-fish.



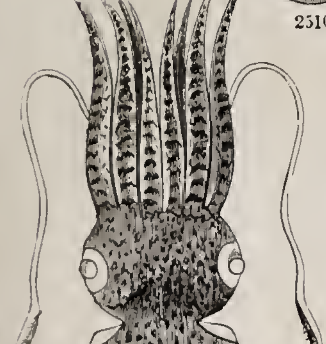
2507.—Cuttle-fish.



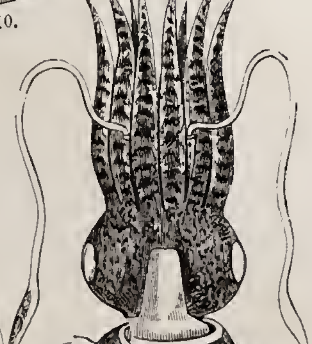
2514.—Head and Arms of Rossia.



2510.



2511.



2512.

Common and Short-armed Sepiolas.

2508.—Suckers of Cuttle-fish.

MOLLUSCA (HETEROGANGLIATA, OWEN).

ON leaving the vertebrate series of animals and entering upon the present, a few words may be deemed requisite.

The title Mollusca, given by Cuvier to the beings included in this grand department of the animal kingdom, conveys an allusion to the general softness of their structure: it has been exchanged by Professor Owen for the term Heterogangliata, in reference to the irregular distribution of the nerves and nervous ganglia, a term now adopted by most physiologists. This extensive section embraces the slugs, the conchiferous and tunicate mollusks, and the cuttle-fishes.

In the heterogangliate animals there is neither an articulated skeleton nor a vertebral column. The nervous system consists of filaments given off from ganglia or knots, disposed in different points, one principal ganglion being situated on the œsophagus, which it encircles with a nervous thread. The want of symmetry in the distribution of the ganglia or nervous centres is in accordance with the absence of symmetry observable in the external configuration of these creatures as well as in the variable arrangements of the internal organs.

The circulation is always double,—in other words there is a systemic as well as pulmonic or branchial circulation; this function is assisted by an aortic ventricle, from which the blood is returned by veins from the aerating apparatus, which first conduct to an auricle. In the cephalopods or cuttle-fishes, there is a pulmonic as well as aortic ventricle, and the pulmonic ventricle is even divided into two; when there is more than one ventricle they are not united, but are often at a distance from each other, representing two distinct hearts. The blood is of a white or pale bluish tint. With regard to the senses, it may be observed that though they appear to be endowed with that of smell, yet no express organ has been detected. Perhaps, as Cuvier remarks, the whole of the external skin receives impressions from the odorous particles of bodies, resembling, as it does, a pituitary membrane. None are endowed with the sense of sight, with the exception of some of the gasteropods, as snails, slugs, &c.; and the pteropods, as the clio, which have eyes; and also the cuttle-fishes, which have not only large bright eyes, but organs of hearing, and a brain enclosed in an osseous case.

The heterogangliata almost invariably present a development of the skin which covers the body, and more or less resembles a mantle; sometimes, indeed, it is reduced to a simple disc; sometimes it meets, and uniting envelopes the body as in a sheath; sometimes it is hollowed like a sac, and occasionally diverges in the likeness of fins.

Many of these animals are naked,—some, however, are housed in shells of varied form and colour.

With regard to the digestive apparatus there is great difference. Generally, however, there are salivary glands, and always a liver of large size. Many have secretions peculiar to themselves.

CLASS CEPHALOPODA (CUTTLE-FISHES).

The Cephalopods may be described as marine animals, having the body surrounded by a mantle in the form of a sac or purse, with a large head crowned with eight or ten long flexible but powerful appendages, always furnished with suckers on their internal surface, by means of which they not only creep along at the bottom of the sea, but grasp their prey and force it into the mouth, which is armed with a parrot-like beak. The branchial pouch communicates with the surrounding medium by a sort of funnel, which projects beyond the edge of the mantle, and opens anteriorly, pointing to the head. All are oviparous.

It is in these creatures alone of the mollusks that definite rudiments of an internal skeleton are to be found. This is, it is true, in a cartilaginous condition, but still it cannot be mistaken; a large cerebral cartilage encloses and protects a ganglion, which may be regarded as a brain, gives attachment to the muscles of the tentacula, encloses an auditory apparatus, and supports the eyes. Other cartilages occur in different parts, composing the rudiment of a spine. But this commencement of a skeleton must not be confounded with a corneous or a calcareous structure contained in a large cavity within the dorsal portion of the mantle, and there secreted by the sides of the chamber itself. In the cuttle-fish (Sepia officinalis) this dorsal plate or gladius is calcareous, consisting of a multitude of laminæ, not closely compacted together, but kept at a little distance apart by minute but very numerous pillars, the whole forming that light and porous structure known in the shops as cuttle-fish bone. In the Calamary (Loligo) this gladius is a long horny substance, somewhat resembling the head of a spear, and often two or three exist in the same cavity. In both cases the plate is analagous to the small lamina found in the mantle of some slugs, and may be regarded as a rudimentary shell, the vestiges of a structure which we shall find developed in the argonaut and nautilus; in which animals we find it assuming the form and use of a true shell, over which the mantle is more or less reflected, but in which the animals are housed; and we may here add that from this circumstance the cephalopods are divided into *naked* and *testaceous*.

In order, however, to understand more clearly the general character of these strange creatures, let us turn to our pictorial specimens, beginning with the poulp, or polypus of the ancients.

Octopus vulgaris, common on the southern coasts of Europe, and found on our own shores.

2506, 2507.—THE COMMON CUTTLE-FISH, OR POLYPUS

(*Octopus vulgaris*). Poulp or Preke. There is something strange and uncouth in the aspect of this creature; its long flexible arms moving and curling in all directions, and its large eyes, which stare with a fixed gaze, rendering it even repulsive.

A cursory observer would predict it ferocious and carnivorous; it is indeed one of the tyrants of the waters, making fishes and crustacea its prey. When crawling at the bottom of the water, the globose body is elevated; the arms or tentacula are spread out, and supported by them it travels along as they seem to bend beneath it. These arms are eight in number, long, narrowing to a point, and in the present species united at their base by a thick web: each of these flexible but vigorous arms is crowded with suckers along its inner aspect to the number of two hundred and upwards. Woe to the fish that is enfolded in their strenuous grasp. Vain is resistance; the suckers adhere with such tenacity that they may be sooner wrenched off than unfixed. Closer and closer to the mouth is the victim brought, it is secured as in a vice, and the work of demolition commences. In some species, as we shall hereafter find, the efficacy of these suckers for holding slippery prey is increased by the addition of a hook, which acts like a grappling iron.

If we look at the suckers of the cuttle-fish, Fig. 2508, we shall see that each consists of an adhesive disc composed of muscular membrane, with a thick fleshy circumference, presenting when expanded a number of radii, converging around the circular orifice of an inner cavity: in this cavity is a movable muscular piston, which, when the sucker is not in action, appears level with the circular aperture; but which, when the disc is closely applied to any object, is drawn strongly back, the cavity it filled being now a large vacuum; the whole is, in fact, an air-pump of most precise and beautiful construction. When the animal releases its hold it relaxes the contractor muscles of the piston, which returning fills the vacuum and the suction ceases.

In our seas none of the cephalopods are large enough to be formidable to man. In the hotter latitudes, however, species of gigantic size have twined their dreaded grasp round human victims and dragged them to destruction. According to Deny de Montfort, Dens, a navigator, avowed that in the African seas, while three of his men were employed during a calm in scraping the sides of his vessel, they were attacked by a monster of this kind which suddenly appeared, seized them in its arms, and drew two of them under water in spite of every effort to save them; and that the thickness of one of the creature's arms, which was cut off in the contest, was at its base equal to that of a fore-yard, whilst the suckers were of the size of ladles. The man who was rescued died delirious during the night. We read also of another crew who were similarly attacked off the coast of Angola: a gigantic cuttle-fish threw its arms across the vessel, and was on the point of dragging it down when the crew succeeded in cutting off its arms with swords and hatchets. When their danger was most imminent they prayed to St. Thomas for aid, and in gratitude for their deliverance dedicated on their return home a picture representing their perilous encounter to the saint in his chapel at St. Malo. Pennant states that in the Indian seas, as a friend of his long resident in the Indian Islands, and a diligent observer of nature, assured him, the Indians affirm that cuttle-fish are often seen two fathoms broad over their centre, with arms nine fathoms long; and that when they go out in boats they are in dread of them, and never sail without an axe for protection. Even on the shores of Sicily Mr. Swainson saw cuttle-fish taken, two of which would be a good load, their arms being as thick as those of a man.

It was probably a species of octopus that Mr. Beale encountered while searching for shells upon the rocks of the Bonin Islands. He was much astonished at seeing at his feet a most extraordinary looking animal crawling towards the surf, which it had only just left. It was creeping on its eight legs, which, from their soft and flexible nature, bent considerably under the weight of its body; so that it was lifted by the efforts of its tentacula only a small distance from the rocks. It appeared much alarmed at seeing him, and made every effort to escape. Mr. Beale endeavoured to stop it by pressing on one of its legs with his foot; but although he used considerable force for that purpose, its strength was so great that it several times liberated its member, in spite of all the efforts he could employ on the wet and slippery rocks. He then laid hold of one of the tentacles with his hand, and held it firmly, so that the limb appeared as if it would be torn asunder by the united efforts of himself and the creature. He then gave it a powerful jerk, wishing to disengage it from the rocks to which it clung so forcibly by its suckers. This effort it effectually resisted; but the moment after, the apparently enraged animal lifted its head with its large projecting eyes, and, loosing its hold of the rocks, suddenly sprang upon Mr. Beale's arm, which he had previously bared to the shoulder for the purpose of thrusting it into holes in the rocks after shells, and clung with its suckers to it with great power, endeavouring to get its beak, which Mr. Beale could now see between the roots of its arms, in a position to bite. Mr. Beale declares that a sensation of horror pervaded his whole frame when he found that this monstrous animal had fixed itself so firmly on his arm. He describes its cold slimy grasp as extremely sickening, and he loudly called to the captain, who was also searching for shells at some distance, to come and release him from his disgusting assailant. The captain quickly came, and taking Mr. Beale down to the boat, during which time the latter was employed in keeping the beak of the cuttle away from his hand, quickly released him by destroying his tormentor with the boat-knife, when he disengaged it by portions at a time. Mr. Beale states that this cephalopod must have measured across its expanded arms about four feet, whilst its body was not bigger than a large clenched hand. It was the species called by the whalers "rock-squid." ('Natural History and Fishery of the Sperm Whale.')

It has already been said that the mouth of the cuttle-fish is placed in the centre of the space enclosed by the arms; it consists externally of a thick circular lip around an orifice; beneath this lip, and partially appearing through the orifice, is a beak like that of a parrot, excepting that the short mandible is the uppermost; these mandibles do not cover bone, but their interior is filled with a fibrous substance of great strength and solidity. In the nautilus these mandibles are blunt, of a calcareous texture, and calculated to crush the shells of mollusks. The muscles in which the jaws of the cuttle-fish are imbedded, and by which they are worked, are extremely powerful. In the ordinary octopus they are capable of stripping off the armour from crabs and lobsters, and of cutting up the flesh of fishes. Within the mandibles is a fleshy tongue invested with a papillose membrane of delicate texture, and also armed with recurved horny papillæ, so that the tongue, by its vermiform action, is easily enabled to transmit the food into the gullet, which passes through a ring in the cranial cartilage, dilates into a spacious crop with glandular walls, whence a short canal leads to a strong muscular gizzard lined with a leathery skin. In this gizzard the food is ground to pulp. At the root of the tongue there are large salivary glands.

We have previously alluded to the connection of the siphon or funnel with the branchial chambers. The branchiæ are situated in a distinct chamber on each side of the body, separated from the viscera by a membranous partition: the branchiæ are very beautiful, consisting each of a single stem with foliated appendages. (The nautilus has two fringed stems in each lateral cavity.) These appendages, which like the gills of fishes are exquisitely vascular, are laved by the water, admitted into each chamber through a valvular aperture, and drawn in

by the dilatation of the muscular investment of the body. Now the forcible contraction of this investment cannot force the water out through the same aperture, it therefore is urged smartly through the funnel or siphon; thus is respiration effected, but as by simple mechanism two ends are often gained in the economy of organic beings, so in this instance the respiratory organs are most efficient means of locomotion; it is by the discharge of the water through the siphon that the cuttle propels itself along in swimming. As the siphon points to the head, and the water is thrown out in that direction, these animals, as must be evident, swim with the head backwards, their eyes being always on the enemy from whom they are escaping; the arms are either closed together and projected so as not to impede them, or act as oars in unison with the action of the branchial cavities. Such species as have paddles or fin-like expansions of the mantle, as the Sepia officinalis, the calamary or flying-squid, are aided by them in their aquatic movements, but in octopus, which has the limbs united by basal webs, the arms by their flapping take an important part in the act of swimming. Thus the cuttle-fish shoots rapidly along, makes sudden darts and leaps; and many species at least, as the calamary, can throw themselves out of the water and take sweeping leaps resembling those of the flying-fish; a circumstance not unknown to Pliny. A learned writer in the 'Penny Cyclopædia' says, "We well remember in our youth going far out with an old fisherman of Dawlish to visit his floating nets which he had laid for the pilchards. As we looked down into the clear blue water we could see that the number of fish entangled was great; but to the great discomfiture of the fisherman, who was eloquent on the occasion, almost every other fish was locked in the embraces of a cuttle-fish plying his parrot-like mandibles to some purpose. The fisherman, who seemed to regard these unbidden guests as an incarnation of all evil, carried a capacious landing-net, but so quick was the sight of these cephalopods, so ready were they in letting go, and agile in darting back or sideways clear of the net, that, though the greedy creatures held on to the last moment, the fisherman did not secure above three out of the crowds that had spoiled his haul."

All have heard of the ink of the cuttle-fish, which forms an admirable tint for painting. It is of a rather dense consistence, and mixes readily with water, a circumstance important to the animal itself, as it is to the discoloration of the surrounding fluid by its admixture that the creature trusts for concealment when threatened with danger. Cuvier drew his figure of the cuttle-fish with ink extracted from its own body. It appears besides that in fossil specimens of extinct species the ink will often retain its character and qualities. Dr. Buckland gave to the late Sir Francis Chantrey a portion of some taken from a fossil specimen, requesting him to try its power as a pigment, and he executed a drawing with a portion of it. The drawing was shown to a celebrated artist, who immediately declared it to be tinted with sepia of excellent quality, and begged to know by what colourman it was prepared: the sepia used in drawing is from the ink-bag of an Indian species of cuttle-fish, whence its name.

Dr. Buckland has the drawings of extinct species executed in their own ink, and from the perfection and repletion of the ink-bag, he infers the sudden destruction and rapid petrifaction of these beings. The ink-bag is differently seated in different species, and is filled up with a spongy cellulosity saturated with the inky matter, which is thrown out in great abundance. In the octopus the ink-bag is enfolded in the mass of the liver; in the calamary it is placed near the funnel; in the sepia near the bottom of the visceral cavity. Wherever it is seated a duct leads from it into the siphon, through which the ink is ejected at the will of the animal. Among the modes of self-preservation with which various creatures are endowed, this is one of the most singular. Cuttle-fish, voracious and strong as they are, have their destroyers, as the grampus and cachalot, &c.: no sooner do their quick eyes behold an advancing enemy than they dart away under the obscurity of a dark train which they leave in their course; they seek the bottom of the water, and remaining quiet and still bury themselves in the sand under cover of a murky cloud, or seek refuge in some hole or fissure in a rock, and there wait till their enemy retires. Most, if not all the naked species, have the power of changing their tints more quickly than the chameleon, and also of ejecting water upon their assailant.

"While looking for marine animals (says Mr. Darwin) with my head about two feet above the rocky shore (of St. Jago), I was more than once saluted by a jet of water accompanied by a slight grating noise. At first I did not know what it was, but afterwards I found out that it was the cuttle-fish, which though concealed in a hole, thus often led me to its discovery. That it possesses the power of ejecting water there is no doubt, and it appeared to me certain that it could moreover take good aim, by directing the tube or siphon on the under side of its body. I observed that one which I kept in the cabin was slightly phosphorescent after dark." The common polypus is said to be luminous at night, and Linnæus refers to a statement by Bartholinus that one gave out so much light when the candle was taken away, that the whole building seemed on fire (ut totum palatium ardere videretur), a palpable exaggeration.

It is not only water that the cuttle-fish ejects as a means of annoyance, but also its ink, and a story is related of an officer who was collecting shells in a pair of immaculate white trowsers, and who inadvertently disturbed one of these animals snugly harboured in a recess of the rock:—"they looked at each other, and the cuttle-fish, who had his eyes about him, seeing the advance of his enemy, took good aim and shot so true, that he covered the snowy inexpressibles with the contents of his ink-bag, and rendered them unrepresentable either in the drawing-room or dining-room." This black fluid was used by the ancients as ink, and the flesh of these animals was highly esteemed by them as delicate food; it is still eaten in Italy and other parts of the continent. Mr. F. D. Bennett states it is considered a luxury by all the classes of the Sandwich islanders, and that when fresh and well cooked it is very good, resembling in flavour and consistence the flesh of a lobster's claw.

The cuttle-fish are divided into octopods (with eight limbs), and into decapods (with ten limbs); to the former belong the octopus vulgaris and the following species.

2509.—THE VENTRICOSE CUTTLE-FISH

(*Eledone ventricosa*). Octopus ventricosus, Grant. In the genus Eledone the arms are provided with a single series of sessile suckers, or acetabula. A beautiful specimen of this animal captured in 1822 at St. Just, Cornwall, is preserved in the Museum of the Royal College of Surgeons. Its arms, which are compressed and connected at their roots by a thick web, have become spirally convoluted, in a very beautiful manner, before death, by their contraction; see the figure, beneath which is a representation (*a*) of one of the suckers. In the decapod cuttle-fish, besides eight arms shorter than in the octopods, are two long additional arms, which are retractile, and furnished with suckers, restricted ordinarily to the enlarged and terminal portion only.

2510.—THE COMMON SEPIOLA

(*Sepiola vulgaris*). In the genus Sepiola the head is large, and, owing to the development of the eyes, equal in width to the body, which is scarcely ventricose, and supported internally by a thin flexible transparent dorsal lamina. Swimming-paddles are extended from the sides of the body.

The common Sepiola is a minute species found on our coasts, about three inches in length; its arms are provided with minute numerous pedunculated suckers; and the two long slender tentacular arms are cylindrical, to near their termination, when they expand a little, and are then furnished with suckers. They proceed as in other decapods from between the third and fourth arms on each side.

2511, 2512.—THE SHORT-ARMED SEPIOLA

(*Sepiola stenodactyla*, Grant). This species, which exceeds the British species in size, is found on the coasts of the Mauritius, whence a specimen was sent to the Zool. Soc. by C. Telfair, Esq., and is described by Dr. Grant, as new to science, in the 'Trans. Zool. Soc.' vol. i. Its proportions are massive, short, and broad, and its colour is a deep purplish brown, extending to the point of the arms, and is produced by closely set spots of that colour; the tentacular arms are cylindrical, but expand towards their termination, presenting there a villose surface, but no suckers. The figures respectively represent the animal in a back and front view.

2513.—THE ARCTIC ROSSIA

(*Rossia palpebrosa*, Owen). In the genus Rossia the body is ventricose; two wide rounded subdorsal fins; anterior margin of the mantle free. Arms rather short, trihedral; the acetabula pedunculated; the peduncles very short, in two alternating rows at the base of the arms, aggregated in many rows at their point: order of the length of the equal arms, one, two, four, three. Tentacula equalling the body in length, furnished at the apex with many very small pedunculated acetabula. Gladius horny, nine lines in length, a little dilated below.

Professor Owen, who established this genus upon a cephalopod brought from the Arctic regions by Captain James Ross, R.N., and taken near the beach at Elwin Bay, Prince Regent's Inlet, on the 29th of August, 1832, states that it differs from Sepiola and Sepioteuthis in the form, proportions, and position of its lateral fins, and in the extent of its horny dorsal style or gladius. In these respects, he observes, it bears a closer affinity to Sepiola, but differs from it generally in having the anterior margin of the mantle free in the whole of its circumference; its natural position is therefore, in his opinion, intermediate to Sepiola and Sepioteuthis, which it connects together, as well by its intermediate size, as by the peculiarities of its structure.

With reference to the development of the skin surrounding the eyeball (whence the trivial name palpebrosa), by means of which this animal evidently possesses the power of defending the eye, Professor Owen thinks that the utility of this provision in seas abounding with ice is obvious. Fig. 2514 shows (in outline) the head and arms of Rossia palpebrosa on the dorsal aspect. 1, 1, the eyes with the lids closed after death: *a*, the eight arms; *a'*, one of the suckers magnified; *b*, the two tentacles; *b'*, a tentacular sucker magnified; *c*, egg-sacs; *d*, eggs.

2515.—THE ROUGH CRANCHIA

(*Cranchia scabra*). This species, which was first figured in the Appendix to Tuckey's 'Congo,' is furnished with a rough bursiform sac, with circular caudal paddles touching each other at their origin; the arms are sessile and unequal; the tentacles pedunculated. It is of small size.

2516.—BANKS'S ONYCHOTEUTHIS

(*Onychoteuthis Banksii*). In this genus the body and fins are as in the genus Loligo; ventro-lateral cartilages of the mantle long and narrow; horny hoops of the tentacular, and sometimes of the brachial, acetabula produced into the forms of hooks or claws.

Gladius or internal support long, broadest in the middle.

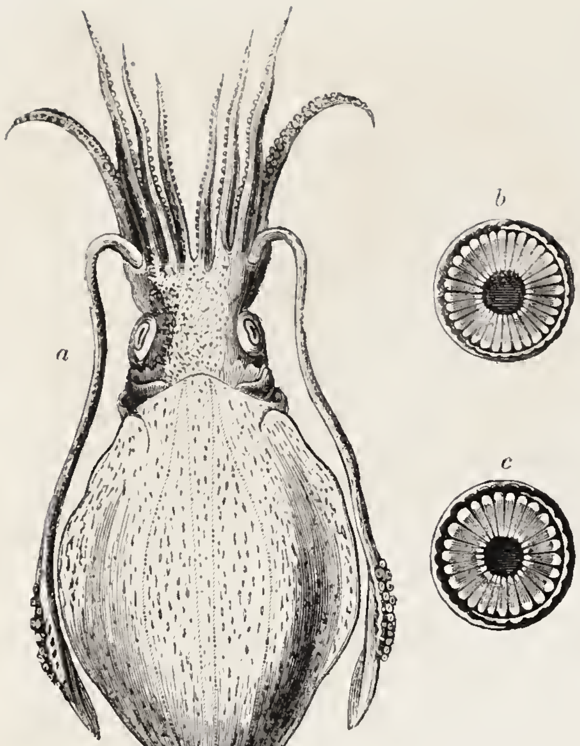
Professor Owen, after dwelling on Dr. Roget's accurate description of the mechanism by which the suckers of octopus are worked, observes that still there are circumstances in which even this remarkable apparatus would be insufficient to enable the cephalopod to fulfil all the offices in the economy of nature for which it was created; and that in those species which have to contend with the agile, slippery, and mucus-clad fishes, more powerful organs of prehension are superadded to the suckers. Thus in the calamary the base of the piston is, he remarks, inclosed by a horny hoop, the outer and anterior margin of which is developed into a series of sharp-pointed curved teeth. These, as he states, can be firmly pressed into the flesh of a struggling prey by the contraction of the surrounding transverse fibres, and can be withdrawn by the action of the retractor fibres of the piston. "Let the reader," adds the Professor, "picture to himself the projecting margin of the horny hoop developed into a long, curved, sharp-pointed claw, and these weapons clustered at the expanded terminations of the tentacles, and arranged in a double alternate series along the whole internal surface of the eight muscular feet, and he will have some idea of the formidable nature of the carnivorous Onychoteuthis.

"Banks and Solander," says Professor Owen in continuation, "in Cook's first voyage, found the dead carcass of a gigantic species of this kind, floating in the sea, between Cape Horn and the Polynesian Islands, in 30° 44′ S. lat., 110° 33′ W. long. It was surrounded by aquatic birds, which were feeding on its remains. From the parts of this specimen which are still preserved in the Hunterian Collection, and which have always strongly excited the attention of naturalists, it must have measured at least six feet from the end of the tail to the end of the tentacles. The natives of the Polynesian Islands, who dive for shell-fish, have a well-founded dread and abhorrence of these formidable cephalopods, and one cannot feel surprised their fears should have perhaps exaggerated their dimensions and destructive attributes."

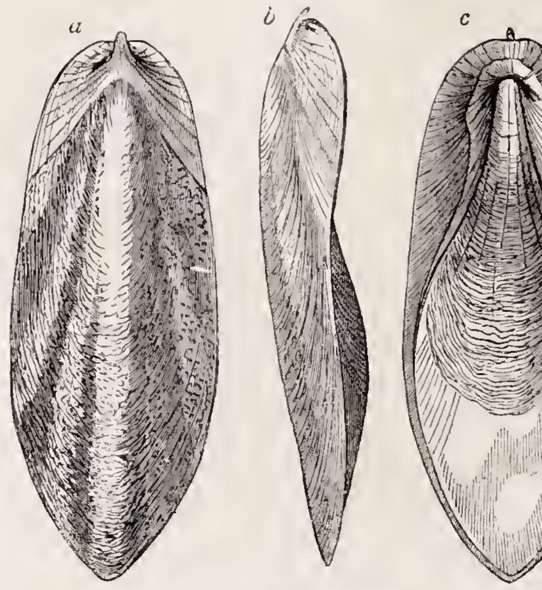
Professor Owen then notices another structure, which adds greatly to the prehensile powers of the uncinated calamaries:—"At the extremities of the long tentacles, besides the uncinated acetabula, a cluster of small, simple, unarmed suckers may be observed at the base of the expanded part. When these latter suckers are applied to one another, the tentacles are firmly locked together at that part, and the united strength of both the elongated peduncles can be applied to drag towards the mouth any resisting object which has been grappled by the terminal hooks. There is no mechanical contrivance which surpasses this structure." The letter *a*, Fig. 2516, represents the gladius. Fig. 2517 represent the hooked suckers.

2518.—THE COMMON CALAMARY

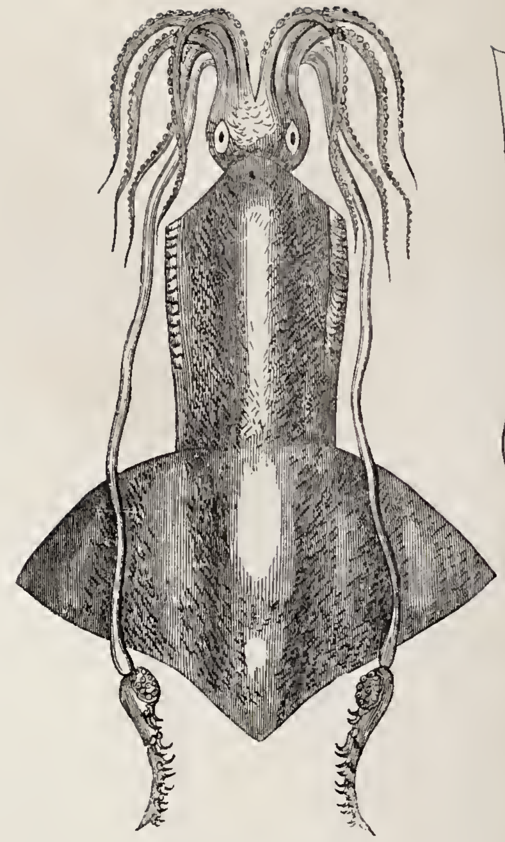
(*Loligo vulgaris*). In this group the body is elongated, cylindrical, provided with a pair of rhomboidal or triangular fins, shorter than the body, and terminal, their apices generally converging to



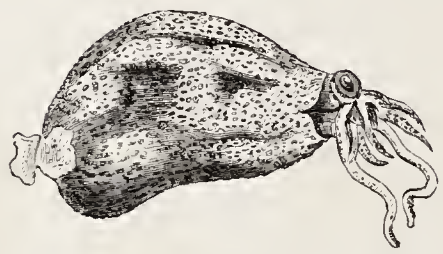
2519.—Officinal Cuttle-fish.



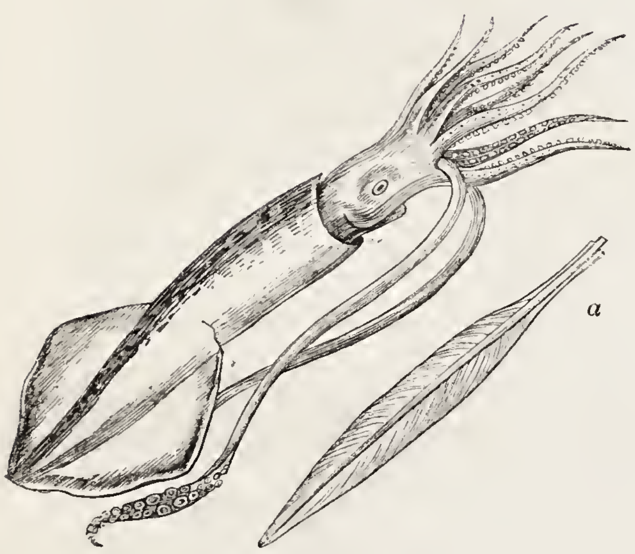
2520.—Internal Shell of Cuttle-fish.



2516.—Banks's Onychoteuthis.



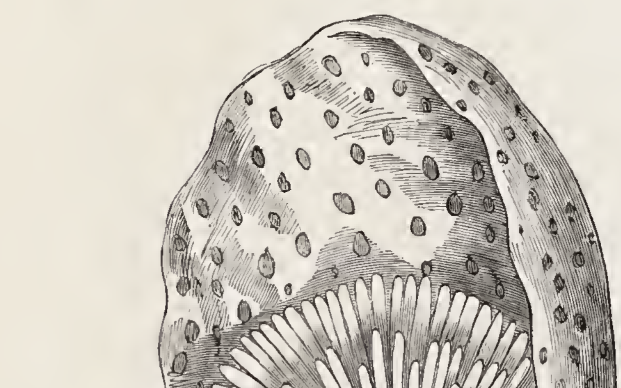
2515.—Rough Cranchia.



2518.—Common Calamary.

2521.—Shell of Pearly Nautilus.

2517.

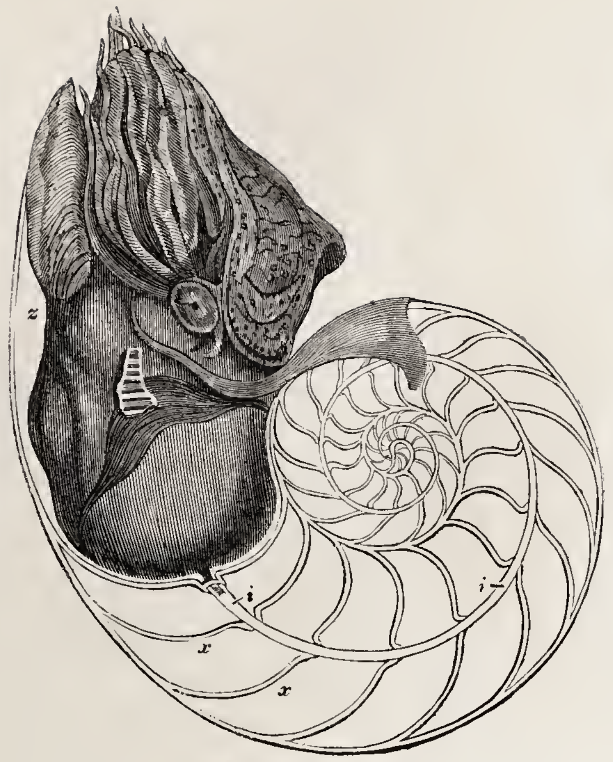


2524.—Nautilus, from Denys de Montford.

2522.—Shell of Umbilicated Nautilus.

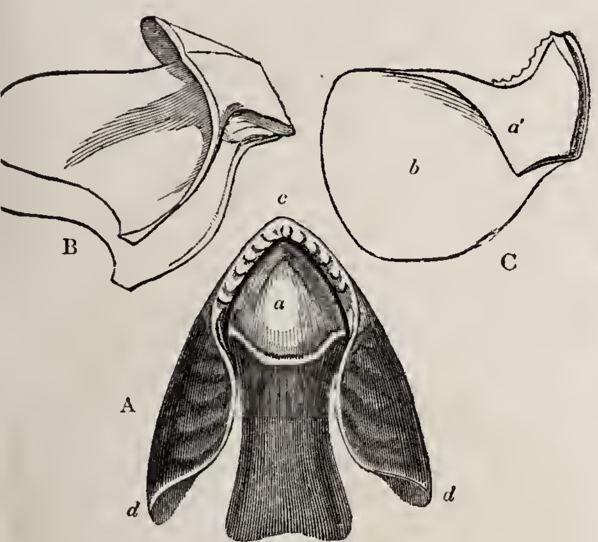
2523.—Nautilus, from Rhumphius.

2534.—Argonaut moving on its head.

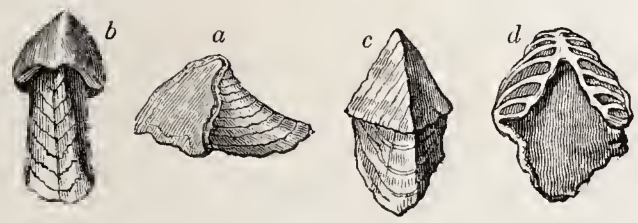


2525.—Pearly Nautilus.

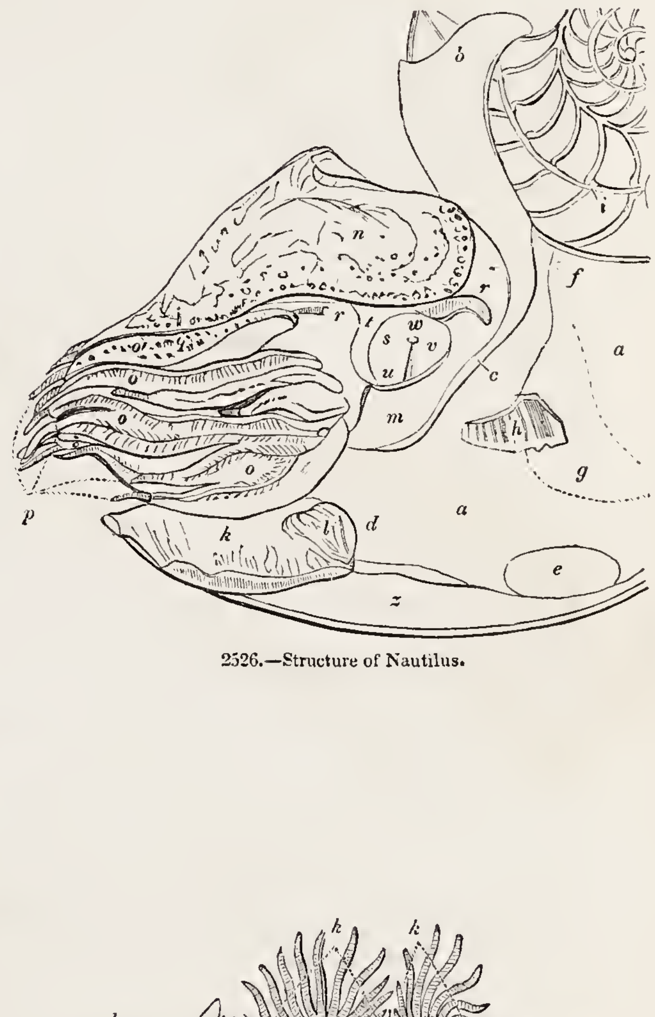
2533.—Arognaut in its shell.



2528.—Mandibles of Nautilus.

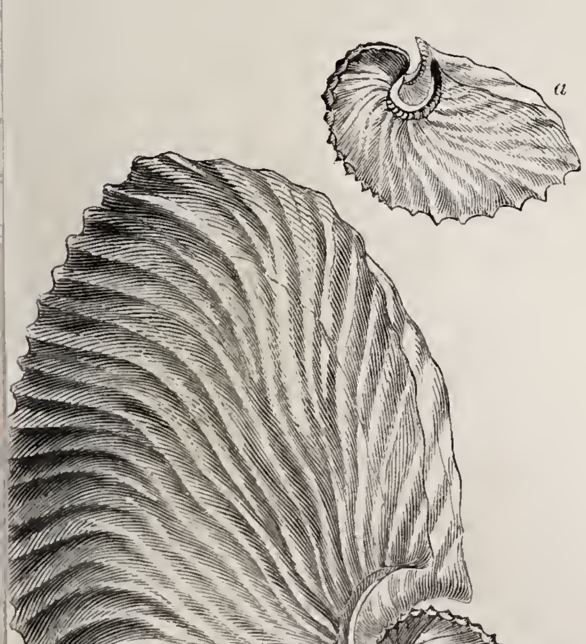


2529.—Rhyncholites.

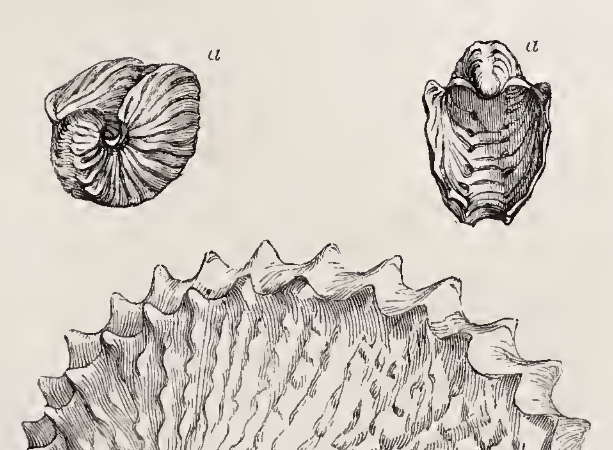


2526.—Structure of Nautilus.

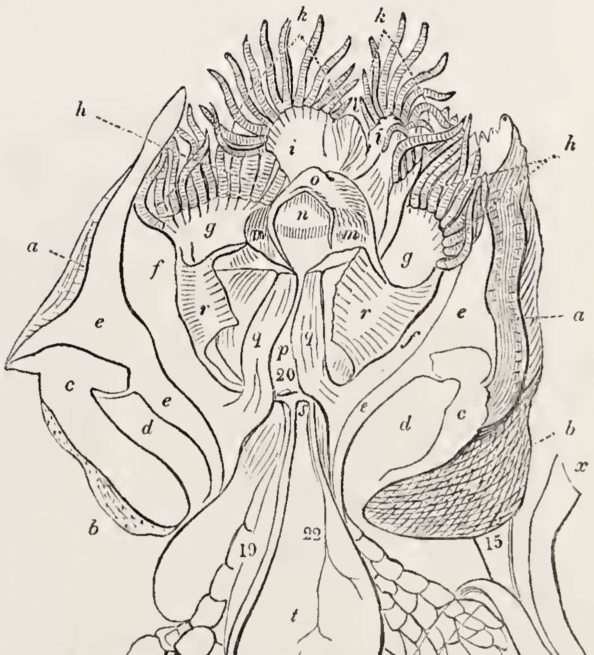
2530.—Wide mouthed Bellerophon.



2531.—Shell of Argonaut.



2532.—Shell of Tuberculous Argonaut.



2527.—Structure of Nautilus.

a point, and united to the end of the mantle; anterior margin of the mantle free. Horny hoops of the acetabula denticulated. Gladius (*a*) long and narrow.

Pennant, under the name of Sepia media, describes this species, which is the common calamary or Penfish (the latter name being derived from the form of its transparent gladius or support), as having an almost transparent body (which is green but convertible into a dirty brown, confirming the remark of Pliny, that they change their colour, adapting it, chameleon-like, to that of the place they are in), and large smaragdine eyes. It is common upon our coasts.

This species is rapid in its movements, and can take leaps analogous to flights, like the flying-fish; an allied species indeed has received the specific appellation of Sagitta (arrow) from the rapidity of its sweeping movements.

Mr. F. D. Bennett, who describes the sea as peculiarly animated between the latitudes 28° and 31° N., and the longitudes 154° and 160° W., observes that the ship was constantly attended by such vast numbers of the albacore, that, when swimming, as is their custom, on the surface of the water, they could be seen as a dense shoal extending several hundred yards on every side of the ship, about which sword-fishes (Xiphias) frequently came, "making destructive onslaughts" on the albacore. More rarely he noticed the barracuda, and transient shoals of bonita. "Flying fish and (nearly allied to these in their movements) flying-squid (Loligo) were also numerous. During a calm in lat. 30° N., the flying-squid appeared in larger flights than we had ever before witnessed; persecuted probably by the albacore (which select this tranquil time to descend deep in the water, and to rove far from the ship in quest of food), they rose from the sea in large flocks, leaping over its smooth surface, much in the same manner, and to the same height and distance, as the flying-fish. Many of them were captured by birds during their leaps,; and one individual, in making a desperate effort to escape some aquatic pursuer, sprang to a considerable height above the bulwarks of the ship, and fell with violence upon the deck."

One kind of Loligo, captured in the Pacific Ocean, in lat. 34° N., which measured six inches in its entire length, must, from the description of its hooks, have been an onychoteuthis. This individual leaped from the sea over the high bulwarks of the ship, and alighted on the deck at a time when vast flocks of the same species were seen leaping around, and often striking with violence against the bows of the vessel, the sea being comparatively smooth. It was much injured by the violence with which it struck the deck. Another species, with its two long tentacles furnished at the extremities with rows of suckers (acetabula) instead of horny hooked appendages, resembling the above in size and form, was obtained in the Pacific. The prevailing colours were silver-white and steel-blue, spread with red spots and tints of violet and purple, a brilliant and very beautiful spot of emerald-green being placed immeditately above each eye. Mr. Bennett concludes by stating that they noticed examples of this family of Cephalopoda from the equator to lats. 34° N. and 16° S. in the Pacific Ocean.

2519.—THE OFFICINAL CUTTLE-FISH

(*Sepia officinalis*). In the genus Sepia, the body is oblong, and depressed with two narrow lateral fins extending its whole length; mantle free at its anterior margin; sucker supported by horny loops, with the margin entire or very minutely denticulated. The internal support is calcareous, laminated, the laminæ supported by columns; it has an internal horny layer, corresponding to the anterior horny sheath in the Belemnites. The officinal cuttle-fish is about a foot in length, and is common in the European seas. Its skin is smooth, whitish, and spotted with brown. The empty eggs of the cuttle-fish in clusters are often thrown upon the beach; *b* is the disc of one of the suckers of this species; *c*, that of Eledone.

Fig. 2520, the internal shell of Sepia officinalis: *a*, the back view; *b*, the side view; *c*, the under side.

We may now pass to the testaceous cephalopods; and of these we shall first turn our attention to the Nautilus.

2521.—THE PEARLY NAUTILUS

(*Nautilus Pompilius*). The shell.

2522.—THE UMBILICATED NAUTILUS

(*Nautilus scrobiculatus*). The shell.

Though known to the ancients and described by Aristotle, it is only recently that the structure of the nautilus has been demonstrated; it is to Professor Owen, whose labours in the field of science are beyond praise, that we owe our knowledge of the organization of this singular being, which from the time of the father of Natural History to the present had remained uninvestigated. That Aristotle was acquainted with the nautilus is very clear: after well describing the naked cephalopods (μαλακια) he says,—"There are also two polypi in shells; one is called by some nautilus, and by others nauticus. It is like the polypus, but its shell resembles a hollow comb or pecten, and is not attached. This polypus ordinarily feeds near the sea-shore; sometimes it is thrown by the waves on the dry land, and the shell falling from it, is caught, and there dies." "The other is in a shell like a snail, and this does not go out of its shell, but remains in it like a snail, and sometimes stretches forth its cirrhi (πλεκτανας)* externally. The first of these animals is evidently the Argonaut, or Paper Nautilus, the latter the true Nautilus. Rumphius, in 1705, gave a figure and description of the nautilus, but the figure (Fig. 2523), which is intended to represent the animal disengaged from the shell, is indefinite, and its details both erroneous and confused. Denys de Montfort, in 'Hist. Nat. des Moll.' (suite au Buffon de Sonnini, Paris, 1802), gives a pretended and most absurd figure of the nautilus, which has been copied by Shaw, and which is below notice (see Fig. 2524).

The specimen which was dissected by Professor Owen was a female, and was captured by G. Bennett, Esq., F.L.S., who thus describes the occurrence. "It was on the 24th of August, 1829 (calm and fine weather, thermometer at noon 79°), in the evening, when the ship Sophia was lying at anchor in Marakini Bay, on the south-west side of the island of Erromanga, one of the new Hebrides group, Southern Pacific Ocean, that something was seen floating on the surface of the water at some distance from the ship; to many it appeared like a small dead tortoise-shell cat, which would have been such an unusual object to be seen in this part of the world that the boat which was alongside the ship at the time was sent for the purpose of ascertaining the nature of the floating object. On approaching near it was observed to be the shell-fish commonly known by the name of the Pearly Nautilus (Nautilus Pompilius); it was captured and brought on board, but the shell was shattered, from from having been struck with the boat-hook in capturing it, as the animal was sinking when the boat approached, and had it not been so damaged it would have escaped. I extracted the fish in a perfect state, which was firmly attached to each side of the upper cavity of the shell. On being brought on board, I observed it retract the tentacula still closer than before, and this was the only sensation of vitality it gave after being caught; I preserved the soft parts immediately in spirits, after making a rude pen-and-ink sketch of its form. On breaking the lower part of the shell, the chambers or cavities were found filled with water. The hood has been stated by Dr. Shaw (Lectures, vol. ii. p. 165) as being of a pale reddish purple colour, with deeper spots and variegations; the colour however, as it appeared in this recent specimen, was of a dark reddish brown, in fact resembling the colour produced by the Koka on the stained cloth of the Tongatabu natives, intermingled with white. We had fine weather; light winds and calms a day or two previous to this animal being caught." After noticing the incorrectness of Shaw's figure (which, as we have above observed, was copied from those given by Denys de Montfort), and the greater general accuracy of that of Rumphius, Mr. Bennett informs us that this species is called Kika, Lapia, and Krang Modang by the natives of Amboyna; and Bia papeda, Bia cojin, by the Malays. He then adverts to another instance of the capture of this animal, by an officer of H.M.S. Ariadne, on a reef at the island of Pemba, near Zanzibar, on the east coast of Africa, in 1824. The animal was not floating upon the water, but was in a hole on the reef, and the officer did not recollect which part of the shell was uppermost. The mantle, like a thin membrane, covered the shell, and was drawn in as soon as it was touched, when the shell was displayed. "I and others," said this officer to Mr. Bennett, "when it was first seen did not notice it, regarding the animal, as the membrane enveloped the shell, merely as a piece of blubber; but having touched it by accident, the membranous covering was withdrawn, and we soon secured our beautiful prize. The fish was a large mass attached to the shell, which we soon extracted and threw away, as we only wanted to collect shells." The same officer compared the mantle to what he had subsequently seen covering the shells of the Harps (Entomostomata), and Cowries (Cypræidæ). Mr. Bennett states that a section of the shell captured by him was afterwards made on board, but none of the appearances, nor whether air or water was contained within, could be recollected. A mate of a whaler, who had been shipwrecked upon the Feejee Islands in the South Pacific, and had resided among that group for nearly three years, told Mr. Bennett that he had seen the shell of the Pearly Nautilus, containing the living animal, floating on the water near one of the islands. He had only seen two living, although the empty shells were very numerous among the islands. The first he saw when in a canoe with some other shipwrecked Europeans; it was then floating on the surface of the water with the mouth of the shell uppermost. It was enveloped in the mantle, which extended some distance upwards, and over the whole of the shell; and it had such an appearance as caused one of the men to say, "There is a large piece of blubber upon the water." On approaching it the animal, retracting the mantle, displayed the beautiful striped shell, and sank before they could capture it. (G. Bennett, Wanderings, vol. ii.)

With respect to the general form of this animal, a reference to Fig. 2525 will convey a better idea than words; a section of the shell in outline is given, showing the siphon, *i i*; the chambers of the camerated shell, *x x*; the septal tubes, which give passage to the membranous siphon; and the chamber of occupation, *z*. We may here observe that from a series of twenty processes or digitations on each side of the head, arise the true tentacula or arms, which are round, tapering, and annulated; indeed each of the processes is hollow, and constitutes a sheath, into which the arm attached to it may be completely withdrawn. Besides these there are labial processes, and laminated appendages at the entrance of the mouth abundantly supplied with nerves. There are no organs of hearing.

Fig. 2526 represents the nautilus and part of the shell in outline explanatory of its structure.

a a, the mantle; *b*, its dorsal fold, applied to the involute convexity of the shell; *c*, its free anterior margin; *d*, the orifice for the passage of the funnel; *e*, the convexity produced by the ovarian gland; *f f*, the horny girdle for the adhesion of the mantle to the shell; *g*, the horny laminæ covering the extremity of the left shell muscle; *h*, a portion of the shell, which was left adhering to this muscle; *i*, the membranous tube or siphon, which traverses the testaceous tubes in the camerated portion of the shell; *k*, the funnel; *l*, the left lateral process of the funnel; *m*, the left crus, or pillar of the funnel; *n*, the hood, or ligamento-muscular disc that surmounts the head; *o o*, the exterior digitations on the left side; *o'*, the larger one, with a papillose surface like that of the hood; *p*, the digitated tentacles, protruded from their sheaths; *q*, the groove which separates the hood from the papillose digitation; *r r*, the ophthalmic receptacles; *s*, the eye; *t*, its peduncle; *u*, the inferior ridge or rudimentary eyelid; *v*, the ridge running from this to *w*, the pupil; *x x x*, the partitions of the chambers; *y y y*, the septal tubes, which give passage to the membranous siphon; *z*, the chamber of occupation. (Owen.)

Fig. 2527 represents the nautilus removed from its shell, in a prone position, with the labial processes and tentacles, the mandibles and the digestive organs, displayed.

a a, the hood, or upper part of the oval sheath longitudinally divided; *b b*, the posterior lobes or angles of the hood; *c c*, the posterior concavity of the hood; *d d*, the ridge in the same; *e e*, the cut surfaces of the above parts; *f f*, the internal surface of the oval sheath; *g g*, the external labial processes; *h h*, the external labial tentacles; *i i*, the internal labial processes; *k k*, the internal labial tentacles; *l*, the olfactory laminæ; *m m*, the circular fringed lip, longitudinally divided; *n*, the superior mandible; *o*, the inferior mandible; *p*, the muscular basis on which the mandibles are fixed; *q q*, the superior pair of muscles which retract the jaws; *r r*, the semicircular muscle which protrudes the jaws, divided longitudinally; *s*, the œsophagus; *t*, the crop; *u*, the narrow canal leading to *v*, the gizzard; *w*, the intestine; *w'*, the terminal fold of intestine drawn out of its situation; *x*, the ejective orifice; *y*, the laminated pancreatic bag; *z*, the liver; 15, a branch of the anterior aorta, which ramifies in the membrane connecting the two portions of the terminal fold of the intestine; 19, the continuation of the posterior aorta along the dorsal aspect of the crop; 20, its bifurcation at the œsophagus, to form a vascular circle corresponding to the nervous circle round that tube; 21 and 22, arteries of the crop, gizzard, &c. (Owen.)

The extent to which the nautilus is covered by its shell, and its close attachment to it, caused Aristotle to compare it to a snail; and, says Professor Owen, "the general resemblance must be sufficiently striking when, with his house above him and in the supine position, he makes his way along the sand with a moderate degree of rapidity. This indeed seems to be the animal's habitual mode of progression; yet it not unfrequently rises to the surface and floats, but the navigation is "in all pro-

* Πλεκτανη, undosus flammarum vortex—the undulating point of a flame, which the arms of the nautilus much resemble when taken collectively.

bability of a passive kind, or influenced only by the action of the respiring currents, when expelled by the funnel, through the surrounding medium; and at all events it can no longer be supposed to have been aided by the fabled sails and oars of the argonaut." The mode of sailing with outspread tentacles is described by Rumphius, who says that in fine weather, after a storm, they are seen in troops thus navigating the seas, like a fleet of pigmy vessels, and that as soon as they wish, they take in their tentacles, upset their boat, and so return to the bottom.

We may here observe, that the tube or siphuncle prolonged through the compartments of the camerated shell of the nautilus is continued from the great venous cavity or pericardium, which freely communicates with the branchial cavities, and which, receiving the water from these cavities, can thus by its contraction transmit it through the siphuncle into the chambers of the shell. These chambers naturally contain air, or some gaseous element, and being thus filled with a fluid more buoyant than water, endow the animal with the means of floating, notwithstanding the density of the shell itself. Now, when the animal wishes to sink, it forces water through the tube, thereby compressing the air, and thus it immediately becomes heavier than the surrounding medium. It would appear that the retraction of the head and tentacles into the shell involve the contraction of the pericardium, and consequently the forcing of water through the tube; while the protrusion of the head and tentacles, by relieving the pericardium from pressure, permits it to expand, when the air of the chambers necessarily drives back the water, and the buoyancy of the animal returns accordingly. Surely no comments are needed to enforce upon the mind a perception of the beauty and fitness of such a contrivance, a contrivance which enables the pearly nautilus to float on the surface of the deep, luxuriating in the light and warmth of the sun; and then in a moment, when danger threatens, to sink to the bottom, and there find a harbour of security.

Fig. 2528 represents the mandibles of the nautilus. A, mandibles of Nautilus Pompilius: *a*, calcareous extremity of upper mandible; *b*, extended internal horny laminæ of the same; *c*, notched calcareous extremity of lower mandible; *d d*, external horny laminæ of the same. B, upper mandible, showing the form of the calcareous extremity, and the proportions of the external and internal horny laminæ. C, one-half of the lower mandible, showing the different proportions of the two horny laminæ, and the extension of the horny substance at *a*, upon which the calcareous matter is deposited; *a'*, the internal horny lamina; *b*, the external horny lamina. Nat. size. (Owen.)

Fig. 2529 represents a series of Rhyncholites, or the fossil beaks of nautili from the oolite (Stonesfield), and the lias of Lyme Regis, &c. They were formerly mistaken for the beaks of birds. *a*, side view (muschelkalk of Luneville); *b*, upper view (same locality); *c*, upper view (lias of Lyme Regis); *d*, calcareous point of an under mandible, internal view, from Luneville. (Buckland.)

2530.—The Wide-mouthed Bellerophon

(*Bellerophon hiulcus.*) A fossil shell, which, though heavier and thicker than the shell of the Argonaut, is one of an allied cephalopod; it is unilocular. It occurs in the mountain limestone formation; and is figured in the late Mr. Martin's 'Petrificata Derbiensia,' T. xl., 1, 2 (1809). The form and situation of the dissepiments, he says, are unknown; they have been since proved not to exist.

We shall now pass to the Argonaut.

2531.—The Argonaut

(*Argonauta Argo*). The shell; *a*, shell of young.

2532.—The Tuberculous Argonaut

(*Argonauta Argo*). The shell; *a*, *a*, Shell of young in two views.

The Argonaut or Paper Nautilus has been ever regarded with interest, and conflicting in the extreme have been the opinions respecting the tenant of the shell, some believing that the real fabricator of this beautiful structure would be ultimately found to be a gasteropodous mollusk, allied to Carinaria (the shell of which is very like that of Argonauta), others contending that the animal usually found in it, always indeed (and the fact has been observed from the earliest periods), where any inhabitant is taken with the shell, viz., a cephalopod, is not only its tenant, but its fabricator, and therefore not a usurper.

And still further:—With respect to the form and habits of this cephalopod, the tenant of the shell, the most extravagant ideas have prevailed. Montgomery, in his 'Pelican Island' thus describes it, in accordance with the accounts promulgated by naturalists,—

"Light as a flake of foam upon the wind,
Keel upwards, from the deep emerged a shell,
Shap'd like the moon e'er half her orb is filled.
Fraught with young life, it righted as it rose,
And moved at will along the yielding water.
The native pilot of this little bark
Put out a tier of oars on either side,
Spread to the wafting breeze a two-fold sail,
And mounted up, and glided down the billow
In happy freedom, pleased to feel the air,
And wander in the luxury of light."

Since the days of Aristotle, the history of the argonaut has been enveloped in a tissue of misconceptions and difficulties. The argonaut has been a centre round which theories and speculations and poetry have revolved, but upon which the scrutiny of rigid and persevering research seemed never to be brought to bear. It is, indeed, only recently that the cloud of doubts and errors which hung around this tenant of the sea has been dissipated; and it is principally to the observations and experiments of Madame Jeannette Power, a French lady residing in Sicily, that the true nature and history of the argonaut, so abundant in the Mediterranean, have been cleared up. The results of her researches, with collections of specimens in illustration of them, have been transmitted by her to the different scientific societies of England, France, and Italy; and Professor Owen and M. Rang have contributed their labours in the elucidation of many points of difficulty and interest.

By way of condensing the matter, it may be stated in the first place, that naturalists have doubted as to the claim of the cephalopod to the shell it is found, and ever has been found, to inhabit, and arguments have been adduced to prove, that, like the hermit crab (Pagurus), it had usurped the shell of another, either during the life, or after the death of its lawful proprietor,—a proprietor which ever remained to be discovered. M. Blainville in France, and many zoologists of rank in this country, adopted this opinion. In the second place, it has been an established opinion that the velated dorsal arms were used as sails to catch the breeze, and that as it floated over the tranquil waters of the sea, or the rippling waves, it was thus wafted onwards.

Now, with reference to the lawful occupation of the shell, it is incontestably proved that the cephalopod in question is the maker of it, and consequently not a usurper of another's right. Specimens in every stage of growth, from young individuals whose shell weighed only a grain and a half, up to those of the ordinary size, have been sent to England, and accurately examined by Professor Owen, to whose observations we shall presently allude. Again, it was found by Madame Power (the fact has been subsequently corroborated), that the shell of the argonaut, while investing the living animal, is not hard as it appears in cabinets, but of a yielding and flexible consistence, with a degree of elasticity, which the mechanism of respiration and locomotion of the animal requires; it is, moreover, diaphanous or permeable to light. It was also proved that while in the egg, the young argonaut, though otherwise in a high stage of development, had neither the membranous velated arms, nor any rudiment of shell; but that both these arms and the shell became developed at a certain period after exclusion, viz., about the tenth or twelfth day.

Another discovery was, that when the shell was fractured, or portions were removed, it was repaired (from the outside) with similar materials to that of the rest of the shell; and that, moreover, the shell was really moulded on the body of the animal, to the form of which it is beautifully adapted, that the relative position of the animal with respect to the shell was invariably the same, and that if removed from the shell the animal speedily died. These facts were ably commented upon by Professor Owen, who, in February, 1839, exhibited at a meeting of the Zool. Soc. specimens of the animal in question and its shell, of all sizes, shells fractured and repaired, and eggs in every stage of development, and who ably confuted the views of M. Blainville.

Now, with respect to the velated dorsal arms, though Madame Power fell into the common error of supposing that they were used as sails, yet she describes them as "being placed next the involuted spire of the shell, over which they are bent, and expanded forwards, so as to cover and conceal the whole of the shell, and from which they are occasionally retracted in the living argonaut." During subsequent experiments she ascertained that these expanded organs are the actual producers of the shell, that to them it owes its original formation, and its reparation when injured; and she justly compares these membranous expansions to the two lobes of the mantle of the cowry, reflected over its shell, and which they produce. "These facts," observes Professor Owen, "are the results of actual observation; and the subsequent observations of M. Rang have fully confirmed the accuracy of Madame Power's description of the relative position of the so called sails of the argonaut to the shell; and he has published some beautiful figures illustrative of this fact."

Among other points noticed by Madame Power, in her memoir, was the great extensibility combined with the forcible pump-like action of the siphon, which emerges from the anterior edge of the marginal opening of the shell, the dorsal surface of the animal's body being always next the involuted spire, or internal wall.

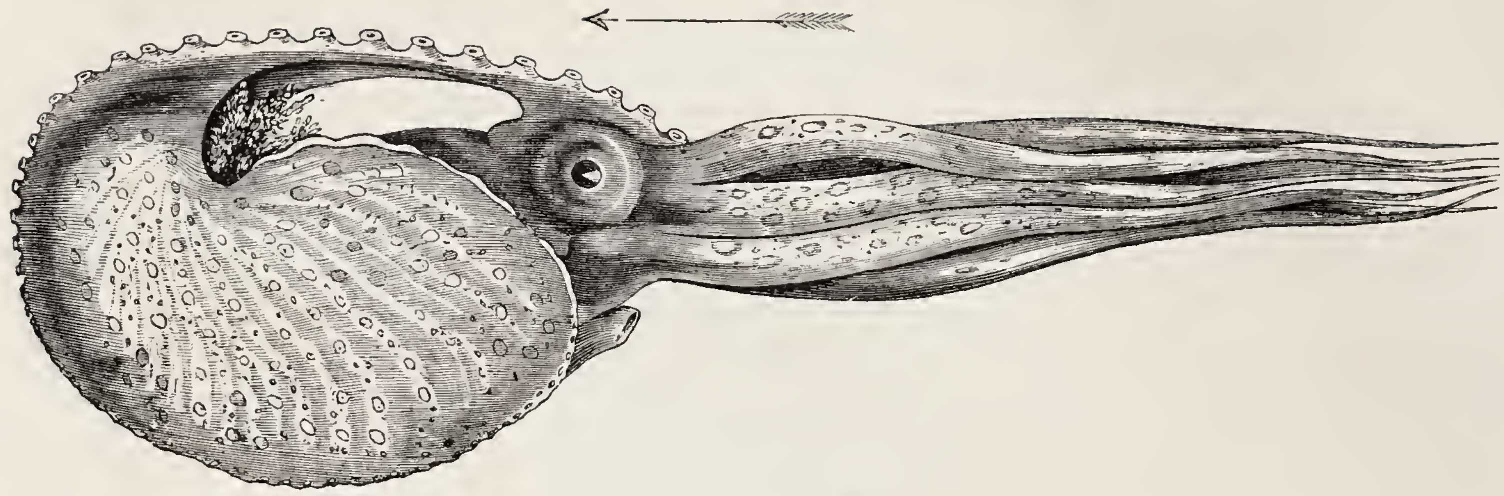
"The proof," says Professor Owen, "that the velated arms possess, like the expansions of the mantle of the Cypræa, a calcifying power, was afforded by the third series of specimens on the table of the Society. These consisted of six shells of the argonaut, from which Madame Power had removed pieces of shell while the argonauts were in life and vigour, in her marine vivarium. One of the shells had been removed from the animal ten minutes after the fracture; another argonaut had lived in the cage two months after being subjected to the experiments: the remaining specimens exhibited intervening periods between the removal of a portion of the shell and its reparation. The fractured shell first described had the breach repaired by a thin transparent membranous film: the piece removed was taken from the middle of the keel. In a second specimen calcareous matter had been deposited at the margins of the membrane, where it was attached to the old shell. In a third specimen, in which a portion of the shell had been removed from the keel, about two inches from the mouth of the shell, the whole breach had been repaired by a calcareous layer, differing only in its greater opacity and irregularity of form from the original shell. In the specimen longest retained after the fracture, a portion had been removed from the margin of the shell: here the new material next the broken edge presented the opacity characteristic of the repairing substance, but the transition of this substance into the material of the shell, subsequently added in the ordinary progress of growth, was so gradual, in the resumption in the repairing material of the ordinary clearness and striated structure of the shell, that it was impossible to doubt but that the reparation as well as the subsequent growth had been effects of the same agent. The repaired parts of the shell reacted precisely like the ordinary shell with nitric acid.

Mr. Owen then observed, that the specimens submitted to the meeting by Madame Power possessed in themselves the means of confirming or refuting her theory of the formative organs of the shell of the argonaut: for if the shell were secreted, as in gastropods, &c., by the edge of the mantle covering the body, the new material by which the breaches of the shell had been repaired should have been deposited on the inside of the fractured edge; but, on the contrary, it was clearly obvious in two of the specimens, that the new material had been laid on upon the outside of the fractured part—as it must have been, supposing the vela or membranous arms to be the calcifying organs."

For abundant details on the structure of the argonaut, we refer to the 'Proceeds. Zool. Soc.' for February, 1839; to which we have previously alluded.

The following interesting account of the living animal and of its actions is from the paper by M. Rang.

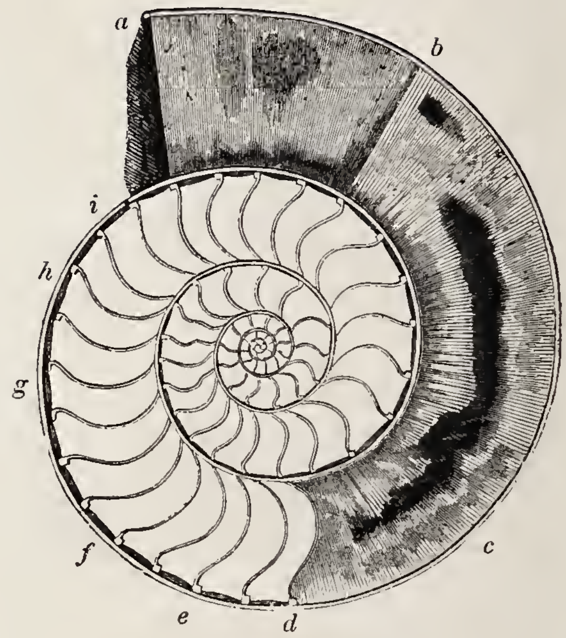
"The poulp, with its shell lying motionless at the bottom of the vase in which we had placed it, struck us at once by the brilliancy of its hues, and their richness; which our sketch is far from conveying. It appeared little more than a shapeless mass, but it was a mass of silver with a cloud of spots of the most beautiful rose colour, and a fine dotting of the same, which heightened its beauty. A long semicircular band of ultra-marine blue, which melted away insensibly, was very decidedly marked at one of its extremities, that is, of the keel. The shell was nowhere visible, but with a little attention we could easily recognise its general form, and we could even distinguish some grooves on its surface as well as the tubercles of the keel. A large membrane covered all; and this membrane was the expanded velation of the arms, which so peculiarly characterize the poulp of the argonaut. The animal was so entirely shut up in its abode, that the head and the base of the arms only, were a very little raised above the edges of the opening of the shell. On each side of the head a small space was left free, allowing the eyes of the mollusk some scope of vision around, and their sharp and fixed gaze appeared to announce that the animal was watching attentively all that passed around it. The slender arms were folded back from their base, and inserted very deeply round the body of the poulp, in such a manner as to fill in part the empty spaces which the head must naturally leave in the much larger opening of the shell. Of these six arms, the two lower ones descended on each side the whole length of the keel, leaving a space between them



2535.—Argonaut swimming.

2537.—Beaked Ammonite.

2544.—Ammonite.

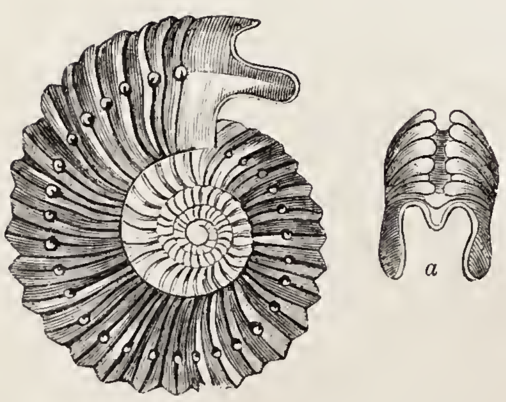


2536.—Shell of Ammonite.

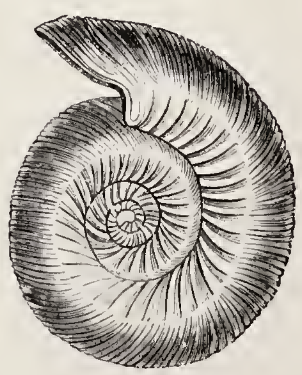
2540.

2538.

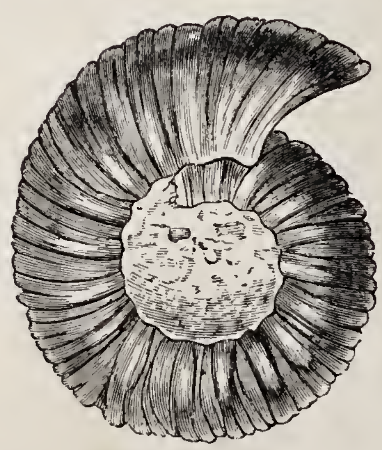
2539.



2541.—Ammonite.



2542.—Ammonite.

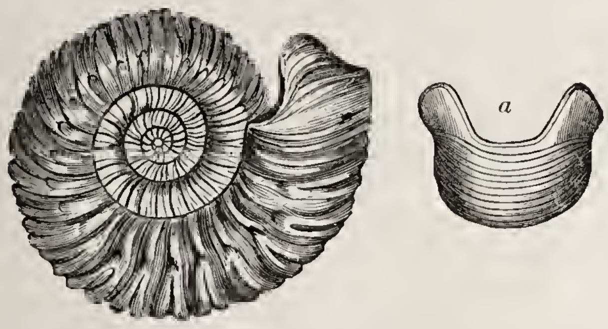


2543.—Ammonite.

2545.—Ammonite: Mouth perfect.

2549.—Section of Ammonite.

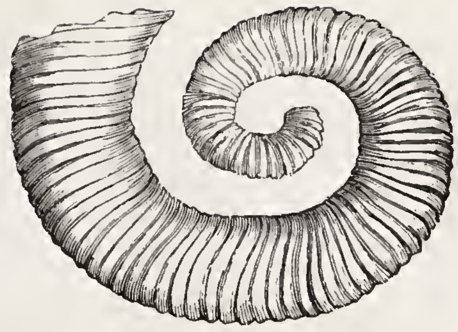
2555.—Gibson's Goniatite.



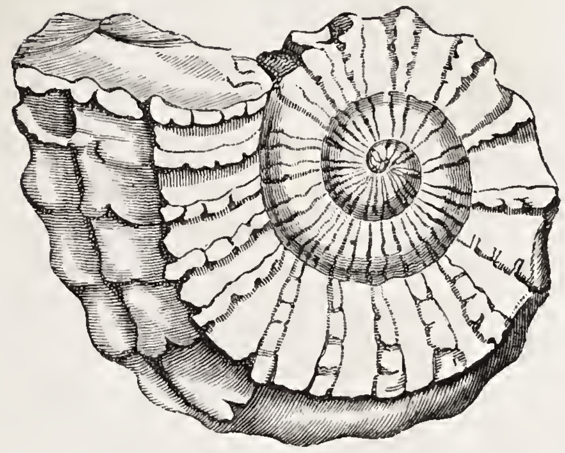
2546.—Ammonite: Mouth perfect.

2554.—Spirorbal Goniatite.

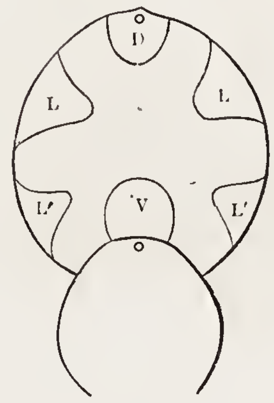
2552.—Truncate Goniatite.



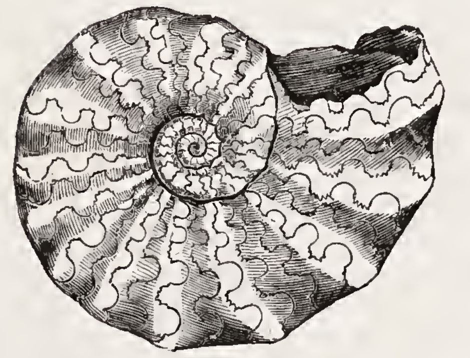
2550.—Duval's Crioceratite.



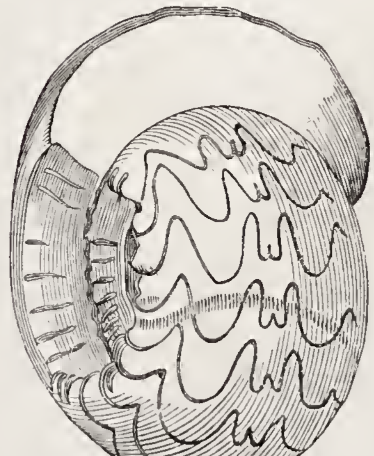
2548.—Ammonite: Mouth imperfect.



2551.



2547.—Ammonites nodosus.



2553.—Lister's Goniatite.

within which we perceived the siphon with its open extremity; while the four other arms were disposed, two on the right, and two on the left, in the middle part of the opening of the shell, contracted and bent irregularly back. As to the higher arms, their disposition was altogether different from that of the others. Prolonging themselves towards the retreating part of the spire one on each side, they encountered the keel by the tangent line; and then, without quitting it, stretched out as far as its anterior extremity, insinuating themselves between the tubercles, and in such a manner, that there remained in the medium line of the keel only a narrow space that was not covered. The membranous portion of these arms dilated beyond any thing we could have pictured to ourselves from a knowledge merely of the animal preserved in spirits of wine, and was spread over the two lateral surfaces of the shell, in such a manner as to cover it completely from the extremity of the spire to the edge of the opening, and consequently of the keel. The application of these membranes was direct and without any puckerings or irregularity whatsoever; the lower part of the two large arms being completely stretched formed a kind of bridge over the cavity left between the back of the poulp and the retreating portion of the spire, in which the extremity of a cluster of eggs was floating." Sometimes, however, the arms are somewhat retracted, drawing back the expansion, and leaving the anterior portion of the shell uncovered. In this condition it is represented at Fig. 2533, which represents the animal contracted within its shell, peeping above its edge, and with the limbs folded down. The eggs are distinctly seen under the bridge made by the velated arms.

"To return to the description of our poulp," says M. Rang, "which we left contracted within the argonaut-shell, and watching, with an attentive eye, what took place around it, we saw it extending itself from out its shell, and protruding six of its arms; then it threw itself into violent motion, and travelled over the basin in all directions, often dashing itself against the sides. In these different movements the body leant a little towards the anterior part of the shell; and the long slender arms, very much extended and collected into a close bundle, were carried before it, as well as the tube, which showed itself open and protruded. The locomotion was effected in the ordinary manner of poulps, the movement being backwards by means of the contraction of the sac and the expulsion of water through the siphon. The disposition of the animal and shell is the most favourable for accelerating the motion of the creature. The lightness of the shell,—its narrow and keeled form,—its width, which is smallest at the part presented first for cleaving the water,—the membrane smoothing over all inequalities of the shell,—the bundle of arms extending behind so as to offer the least possible resistance,—the two arms stretched like a bridge over the cavity where the eggs are as if to throw off the water from that cavity;—all these adaptations concur to facilitate the gliding of the animal through the medium in which it is to move."

M. Rang thought that he perceived in the movements of the animal, when in open water, that it had its back uppermost, and consequently the tube below; but he did not constantly see it so; he observed it however with more certainty in specimens of poulps whose arms had been deprived of their membranes.

The animal which they had been watching, as above described, fatigued by its efforts in a confined space, and perhaps injured by the shocks which it had sustained in coming in contact with the side of the basin, allowed itself to sink to the bottom, and half contracted itself in order to take repose; soon after which it exhibited another and unexpected spectacle. Fixing some of the acetabula, or suckers, of its fore-arms upon the bottom of the basin, it erected itself straight upon its head, spreading out its disc, and carrying the shell above it in the ordinary manner of shelled gasteropods (snails); then beginning to crawl, it presented the appearance of a pectinibranchiate mollusk. Half drawn back into its shell, the animal appeared to crawl upon its disc, the palmatures of which were a little raised, to follow the movements of its arms; the body was hidden in the shell, the siphon placed in the anterior part of it was turned forwards, the arms, which were at liberty, were very much protruded, and twisting round, two before, and two on each side; the base of the two large velated arms seemed to prolong the locomotive surface backwards, and then, rising along the keel, they covered it with their large membranes as when the poulp was swimming in deep water. "Thus," continues M. Rang, "this mollusk, at once pelagic and littoral, presents a most singular anomaly, when it swims at the surface of the water having its ventral part lowermost, and when it crawls along the bottom, having it on the contrary uppermost; two things which are completely contrary to what we see among the marine mollusks on the one hand, and the littoral mollusks on the other." Fig. 2534 represents the Argonaut moving on its head at the bottom.

Fig. 2535 represents the position of the animal while propelling itself through the water in the act of swimming. The arrow indicates the direction of the animal; the siphon, throwing out successive gushes of water, is seen under the extended arms.

While crawling along the progress made was slow, and it seemed to work its way like a snail, but this motion was only apparently reptant, for the suckers were the organs of locomotion.

When the poulp was at the point of death, it drew in by slow degrees its large arms and their membranes, and contracted them upon themselves and all the other arms, so as to obstruct the opening of the shell. At this moment the shell was moved, and the poulp separated itself from it, not voluntarily but accidentally, for it no longer held it in any way. It appeared at first to become a little reanimated, made some movements in the basin upon its head, then fell from weakness, and soon died. All this passed in less than ten minutes.

Another form of shelled cephalopod is presented to us in the Spirula. The shell is concealed under the mantle at the lower part of the body, and is spiral, but the whorls are separated from each other instead of being contiguous; internally it is divided into chambers perforated by a siphon, and the last or external turn of the spire is prolonged in a straight line. Our information respecting the Spirula is very limited.

In the Ammonites, Belemnites, &c., we are presented with the fossil relics in great abundance of extinct testaceous cephalopods; and certain distinct forms of them are characteristic of certain systems of rocks. According to Dr. Buckland the family of the Ammonites * extends through the entire series of the fossiliferous formations from the transition strata to the chalk inclusive. Cuvier appeared to consider the Ammonites as internal shells, like Spirula; and found one reason in the smallness of the outer chamber of lodgment; but in the opinion of Professors Owen and Buckland, they were external shells; in the outer chamber of which the animal resided. The latter thus writes:—"The smallness of the outer chamber or place of lodgment for the animal is advanced by Cuvier in favour of his opinion, that Ammonites, like the Spirula, were internal shells. This reason is probably founded on observations made upon imperfect specimens. The outer chamber of the Ammonites is very seldom preserved in a perfect state; but when this happens, it is found to bear at least as large a proportion to the chambered part of the shell, as the outer cell of the Nautilus Pompilius bears to the chambered interior of that shell. It often occupies more than half, and in some cases the whole circumference, of the outer whorl. This open chamber is not thin and feeble like the long anterior chamber of the Spirula, which is placed within the body of the animal, producing this shell, but is nearly of equal thickness with the close chambers of the Ammonite."

Fig. 2536 represents a Section of Ammonites Obtusus; *a*, *b*, *c*, *d*, the outer chamber; the siphon or tube of communication may be traced from *d*, where it opens into the last or outer chamber, along the edge of the section, *e*, *f*, *g*, *h*, *i*, to the very nucleus of the shell; the waved transverse lines represent the partitions of the chambers.

In some species the margin of the outer chamber is reflected and thickened, in some it is prolonged into a beak; some species are furnished with spines, others are rugose.

Fig. 2537 represents the Beaked Ammonite (A. rostratus). Figs. 2538, 2539, 2540, 2541 (*a*, rim of mouth), 2542, 2543, and 2544, exhibit various species of Ammonites, with perfect mouths, the outlines of which may be compared.

Figs. 2545 and 2546 exhibit other specimens of perfect-mouthed ammonites (*a*, outline of the mouth of Fig. 2546), and Fig. 2547, the Ammonites nodosus, which will convey an idea of the concamerations in some of the species. Fig. 2548 represents an ammonite with an imperfect mouth, and Fig. 2549 a section.

As the ammonites, of which about two hundred and twenty-three species are distinguished, were evidently principal agents for keeping within bounds the mollusks, &c., the crustaceans, and perhaps fishes of the periods prior to the chalk formation, and belonging to the latter epoch, we should expect to find them widely distributed. Accordingly, they occur in Europe, Asia, and America, in strata apparently of the same date. In some instances, the genera and even the species are identical. Dr. Gerard found in the Himalaya Mountains, at an elevation of sixteen thousand feet, Ammonites Walcotii and Ammonites communis, fossils that are found in the lias of Lyme Regis. M. Ménard met with one in the Maritime Alps at an elevation of one thousand five hundred toises. Their numbers must have been great: M. Dufresne informed Lamarck that the road from Auxerre to Avalon in Burgundy was absolutely paved with them. The individual agency too of some of these carnivorous instruments for preserving the balance of marine animal power must have been of no small importance. Lamarck says that he has seen ammonites of two feet (French) in diameter. Mr. James Sowerby and Mr. Mantell record ammonites in the chalk with a diameter of three feet; and Dr. Buckland states that Sir T. Harvey and Mr. Keith measured ammonites in the chalk near Margate which exceeded four feet in diameter; and this in cases where the diameter could have been in a very small degree enlarged by pressure.

Dr. Buckland is of opinion that the Rhyncholites, or beakstones, which occur so abundantly in the oolite of Stonesfield, in the lias at Lyme Regis and Bath, in the muschelkalk of Luneville, &c., were the mandibles of ammonites as well as of fossil nautili, and there can be no reasonable doubt of the fact.

It would appear that the ammonites, or rather the cephalopods inhabiting these shells, had no ink-bags; but for much information on this and other points we refer to Dr. Buckland's Bridgewater Treatise, in which their history is copiously illustrated.

2550.—DUVAL'S CRIOCERATITE

(*Crioceratites Duvallii*). This fossil shell is closely allied to the Ammonites, but the whorls are apart and not contiguous as in the latter. This form has received from Mr. Sowerby the generic title of Tropæum.

We may now pass to a group of the shells of extinct cephalopods, termed Goniatites, a group of equal importance with the ammonites, in reasoning on the succession of organic life on the globe. Between these shells and the ammonites there are important distinctions. In the ammonites the siphon, as we have seen, instead of perforating the disc or centre of the transverse plates dividing the chambers (as in nautilus), touches and runs parallel to the inner surface of the shell on the dorsal line. Another characteristic of the ammonites is in the form of the sutures or intersections of the transverse internal septa, or plates, with the inner surface of the shell; these sutures in ammonites are undulated or angularly bent into lobes and sinuses, seldom zigzag: in nautilus they are even, or gently waved, but in goniatites the forms of the sutures are in general singularly waved, zigzag, and greatly varied. Von Buch regards the sinuous edges of the septa of the ammonites and goniatites to be necessarily derived from the dorsal position of the siphuncle; "all the other differences," he says, "are derived from this primary distinction. The nautilus, which passes a very large siphon through the middle of the septa, appears sufficiently attached by this membranous basis on which it rests. There is no need of any other support, and the septa in general remain smooth, and concave without sinuosities on the edges. The small dorsal siphon of the ammonites (and goniatites, which Von Buch regarded as included in that group) would not suffice to secure the animal from displacement on the surface of its cell." He contends that other supports are needed, and that they are to be found in the marginal lobes, which the form of the goniatites, in particular, impresses on the partitions of the chambers, and which are generally six in number, as seen at Fig. 2551. One ventral, V; one dorsal, D; and two on each side, L. L., L'. L'.

The species of Goniatite are rather numerous: the late Mr. Martin in his 'Petrificata Derbiensia,' figured two species from the limestone; Mr. Sowerby, in the 'Mineral Conchology of Great Britain,' added two others; and Professor Phillips, in the 'Illustration of the Geology of Yorkshire,' has raised the number of British species to thirty-six; of these the septa are completely ascertained. These, added to the distinct continental species, make up a total of seventy-one or seventy-two, with which naturalists are acquainted.

With respect to their external form, the goniatites form a sub-globular figure, to the discoid spiral shape of the flattest ammonites. Most have rounded backs, a few have the back carinated. In general the lines of growth externally visible are sigmoidally waved; sometimes, however, the striæ are annular, sometimes radiating; occasionally the striæ rise into tubercles on the inner edge of the whorls.

2552.—THE TRUNCATE GONIATITE

(*Goniatites truncatus*). In this species the striæ are sigmoid.

* Formerly called Cornua Ammonis, Horns of Jupiter Ammon; whence the modern term Ammonite.

2553.—LISTER'S GONIATITE

(*Goniatites Listeri*). In this species the striæ rise into ridges on the inner edge of the whorls.

2554.—THE SPIRORBAL GONIATITE

(*Goniatites spirorbis*). This species is remarkable for the multitudinous inner whorls.

2555.—GIBSON'S GONIATITE

(*Goniatites Gibsoni*). In this species the striæ are divided as in many ammonites.

We may now turn to the sutures of the goniatites, which exhibit the most singular curves, flexures, and zigzags. The following arrangement, and the accompanying figures, will show the principal variations in the sutures, which are very interesting, and which may be compared with actual specimens by those who possess them. The arrow in each case is supposed to point towards the aperture.

Division 1. The dorsal lobe simple, one lateral lobe.

Lateral lobe single and rounded; Fig. 2556, Goniatites expansus.

Lateral lobe single and angular; Fig. 2557, Goniatites sublævis.

Division 2. Dorsal lobe simple, more than one lateral lobe.

Lateral lobes linguiform and nearly equal; Fig. 2558, Goniatites Henslowi.

Lateral lobes rounded and nearly equal; Fig. 2559, Goniatites Serpentinus.

Inner lateral lobes very much the largest; Fig. 2560, Goniatites Munsteri.

Lateral lobes very unequal and oblique; Fig. 2561, Goniatites Hæninghausi.

Division 3. Dorsal lobe divided; lateral lobe single.

Lateral lobes and sinuses rounded; Fig. 2562, Goniatites bidorsalis.

Lateral lobes and sinuses angular; Fig. 2563, Goinatites striatus.

Division 4. Dorsal lobe divided or complicated; lateral lobes more than one.

Lobes rounded or loop-like; Fig. 2564, Goniatites cyclolobus.

It may here be observed that the same transition rocks, which contain a large portion of the continental species of goniatites, yield also examples of a cognate group, from which indeed they are with difficulty to be distinguished. These have received the name of Clymenia; and it has been observed "that if the goniatites are considered as of the ammonoid type, the clymenia may be regarded as of the nautiloid type." Their siphon is always on the inner margin, and the septa, instead of a reflex wave, on the dorsal line, have a bend forward towards the aperture. The clymeniæ have all the variations of form and surface which obtain among the goniatites. The following figures represent the variations of the suture in several species:—

Fig. 2565, Clymenia lævigata.
Fig. 2566, Clymenia compressa.
Fig. 2567, Clymenia planorbiformis.
Fig. 2568, Clymenia striata.

Figs. 2569 and 2570 exhibit a comparison between the suture of a species of ammonite, and one of an allied group, termed Ceratites, supposed to be peculiar to the muschelkalk.

Fig. 2571, Ammonites planicostatus.
Fig. 2572, Ceratites nodosus.

As other examples of the sutures of ammonites, we may refer to the following:—

Fig. 2573, Ammonites sublævis, from Kelloway Rock.

Fig. 2574, Ammonites venustus, from Speeton Clay.

Fig. 2575, Ammonites Waleotii, from the lias.

Another group of fossil shells inhabited by eephalopodous tenants is termed Baculites. This genus was first disecovered by Faujas de St. Fond in the limestone of Maestricht, and is found in the limestone of Valognes, in Normandy, in considerable abundance. The shell is straight, more or less compressed, conical or rather tapering to a point, and very much elongated. The chambers are sinuous and pierced by a marginal siphon; and the last chamber is several inches in length. Fig. 2576 represents the Baculites vertebralis; *a*, *b*, portions of the fossil shell, exhibiting the character of the sutures; *c* is a detached joint.

Another fossil form of the ammonite group is that termed Turrilites. In this genus the shell is spiral, turreted, and chambered; the chambers are divided by sinuous septa, the siphon piercing their discs. The aperture is round.

It would appear, that the shells of this form among the extinct cephalopods are all sinistrorsal, and the septa have the sinuosities of the ammonites. According to Mr. Sowerby, the siphuncle is situated near the upper part of the whorls, and the cavity beyond the last enclosed chamber is very large, so that the shell was external and tenanted as in the ease of the nautilus. In our island specimens of this genus occur in the chalk and green sand; and similar strata on the continent also afford them. Fig. 2577 represents an imperfect specimen of Turrilites costatus.

Another fossil group of shells, belonging to extinct cephalopods, are the Belemnites, Orthoceratites, Cyrtoceratites, &c. The belemnites, which have been termed arrow-heads, thunderstones, &c., and which have been also regarded by some as the teeth of some unknown strange animal, and by others as the spines of some species of echinus, to say nothing of many vague conjectures besides, are extremely abundant in the chalk formations, in the lias and the oolite. They are evidently internal shells analogous to those of the sepia officinalis, but more solid, and of a different figure, being long, and conical. M. de Blainville, in his memoir published at Paris, in 1827, has separated the genus Belemnites into many divisions according to the shape of the shells, and has recorded a great many species.

Professor Agassiz is of opinion that the fossil ink-bags of cuttle-fish, found in the lias at Lyme Regis, belonged to Belemnites, and the reasons upon which he founds this conclusion are derived from the fact that specimens of the belemnite have been discovered presenting the ink-bag *in situ*. Fig. 2578 represents Belemnites canaliculatus with a portion removed, showing the internal chambered part. Miller, in his paper in the 'Transactions of the Geological Society,' gives the following as the generic characters of the belemnites.

"A cephalopodous molluscous animal provided with a fibrous spathose conical shell, divided by transverse concave septa into separate cells or chambers, and inserted into a solid, laminar, fibrous, spathose, subconical, or fusiform body, extending beyond it, and forming a protecting guard or sheath." To this may be added that it was internal, like the gladius of the calamary or the 'bone' of the cuttle-fish.

To the Silurian rocks, the Devonian, and the carboniferous or mountain limestone systems of Europe and North America, belong the fossil Orthoceratites. The true orthoceratites are straight and conical in form, with dissepiments or sutures approximate, concave, oblique, with a slight wave in front, or in that part of the shell where the siphuncle is situated. The siphuncle is small, and placed between the edge and centre of the septa or dissepiment. These fossils in many places have been erroneously regarded as crocodiles' tails. The late Mr. Martin, in his 'Petrificata Derbiensia,' who figures two species from the black marble at Ashford, observes; "The crocodile, said to have been found in the limestone at Ashford, appears to be nothing more than a particularly large specimen of this or some other orthoceratite, probably the species we have figured in the 38th plate;" and he adds, "as a further confirmation of the opinion we have formed respecting this supposed crocodile, we have to remark that the men who now work in the marble quarries at Ashford continue to call the orthoceratites, when they meet with them, crocodiles' tails, agreeably to the idea which was first entertained on finding these bodies."

Fig. 2579 represents the Orthoceras laterale.

It has been remarked that "the cases are few in which the apex of orthoceratites has been actually observed;" and that "in several cases of supposed straight shells the apical part is seen to be curved," whence it is probable that the term orthoceras (ορθος, straight; κερας, a horn) is not universally or strictly applicable.

Among the numerous allied genera we may allude to the following species:—

Fig. 2580, Cyrtoceras depressum.
Fig. 2581, Lituites articulatus.
Figs. 2582 and 2583, Phragmoceras ventrieosum.

In classing the bent or partially convoluted polythalamacea, we may find advantage in attending to the situation of the siphuncle. For example, the siphuncle is subdorsal or approaches the outer line of curvature in Cyrtoceras, Goldfuss, and Gyroceras, Meyer; it is subcentral in Lituites, Breyn; and it is subcentral or approaches the inner line of curvature in the genus Phragmoceras, Broderip.

The geological distribution of these forms is nearly as in the orthocerata. They are all peculiar to the strata below the new red system; and mostly occur below the carboniferous or mountain limestone. Phragmoceras prevails in the Ludlow rocks; Cyrtoceras specially abounds in the strata of South Devon, the Eifel, and the mountain limestone; and Gyroceras and Lituites follow nearly the same rule; a few species of Lituites occur in the Silurian rocks.

The brief characters of the generic groups which follow may be sufficient for the recognition of perfect specimens, but such are rarely found in the older rocks, where alone they occur.

Cyrtoceras (κυρτος, curved, and κερας, a horn), Goldfuss. Bent, arched, or partially convoluted, the free end being sometimes elongated and straight. Septal edges seldom free from a slight waving; siphuncle subdorsal, or even marginal, seldom quite round; aperture nearly orbicular.

Example, Cyrtoceras depressum. From the Eifel.

Several other species occur in Devonshire near Ludlow, &c.

Gyroceras (γυρος, incurved; κερας, a horn), Meyer. Coiled like a tendril, so that the volutions do not touch. Septal edge even, siphuncle dorsal, marginal. Aperture nearly round.

Gyroceras gracile, Meyer. Bronn, in 'Leth. Geog.,' vol. i., fig. 6. From the states of Dillenburg.

Lituites, Breyn. Convoluted, so that the volutions touch in all the inner part, but afterwards extended into a straight or bent portion. Septa pierced by a subcentral siphuncle. Aperture nearly round.

Example, Lituites articulatus, Sow.

Phragmoceras (φραγμα, septum; κερας, a horn), Broderip. Shell incurved and compressed, more or less conical; septal edges entire, crossed externally by the lines of growth; siphuncle near the inner margin; aperture contracted at the middle, its outer extremity produced into an elongated beak.

Example, Phragmoceras ventricosum. Brodcrip, in 'Silurian Researches.'

Among the fossils derived from extinct species of eephalopods, are those constituting the genus Beloptera, established by Deshayes, and described by M. de Blainville as belonging to a form entirely unknown, but which was characterized by containing in the back part of its muscular envelop a symmetrical calcareous or bony shell, formed of a thick solid summit very much loaded behind, and a front tube more or less complete, the cavity of which is conical and annular, the shell or bone having wing-shaped appendages without any anterior shield-like prolongation.

De Blainville divides the genus into two sections. The first consists of species whose wing-shaped appendages are united below the summit, and whose cavity is somewhat in the shape of a scuttle (hotte); of this section Beloptera sepioidea is an example. (Fig. 2584.)

The second includes species whose wing-shaped appendages are distinct, and whose cavity is completely conical, with traces of chambers and of a siphon. Of this division Beloptera belemnoidea is an illustration. (Fig. 2585.)

De Blainville observes that this genus ought to be placed at the end of the sepiacea or cuttles; and that the first of the species is evidently very much allied to the bones of those animals, while the second approaches to the belemnites.

After all, the probability is that these bodies are only portions of the bones of some of the cuttle-fishes; and this appears to have been the opinion of Cuvier.

If a perfect bone of the eommon species of our coasts be closely examined, a structure very analogous to the conical circularly-grooved cavity of Beloptera, although in a more expanded form, will be observed. These fossils have been found in the London clay, and other beds above the chalk.

Voltz, in his memoir on Belemnites, makes Beloptera sepioidea a distinct genus under the name of Belosæpia.

CLASS PTEROPODA

(PTEROPODS, as Clio, Hyalæa, &c.). The Pteropoda, or wing-footed mollusks, are so ealled because they are constructed for moving through the waters, of which they are the tenants, by means of expanded fin-like membranes, placed on each side of the head; some, as the Clio, so abundant in the northern seas, are covered with a contractile envelop, but are otherwise naked and destitute of a mantle. Others, as the Hyalæa, Spiratella, and Cleodora, have a mantle protected by a shell; all are bisexual.

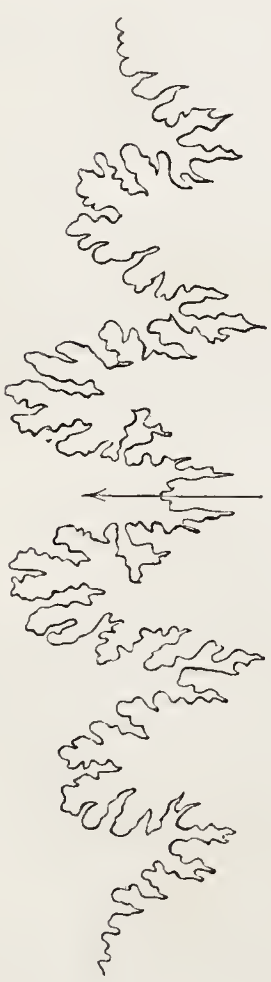
2586.—THE POLAR CLIO

(*Clio borealis*). The Clio borealis may be described as a sort of marine slug with a pair of wing-like fins or oars attached to each side of the neck, by means of which the animal rows itself merrily along, and sports amidst the waters of the Polar Sea, rising and descending at pleasure.

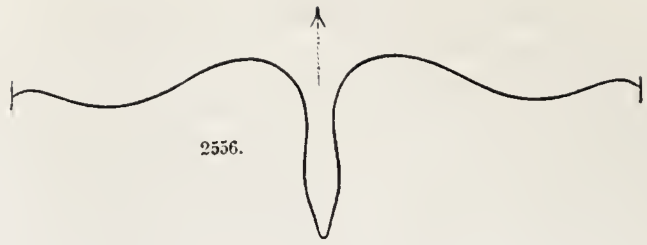
These oars are made up of muscular fibres, which pass through the neck from one expanded appendage to the other, so that the organ is in fact single, and may be compared to the double paddled oar with which the Greenlander propels and steers his

2577.—Turrilites costatus: imperfect.

2575.

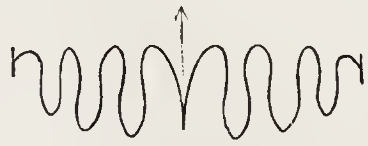


2573.



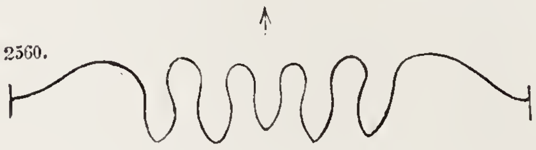
2556.

2557.

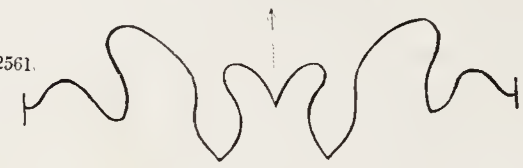


2558.

2559.



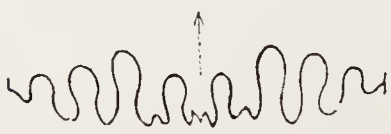
2560.



2561.

2562.

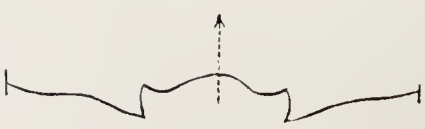
2563.



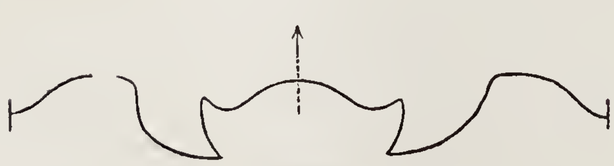
2564.

2565.

2566.

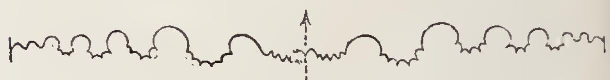


2567.

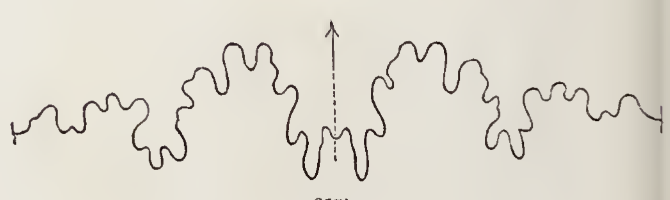


2568.

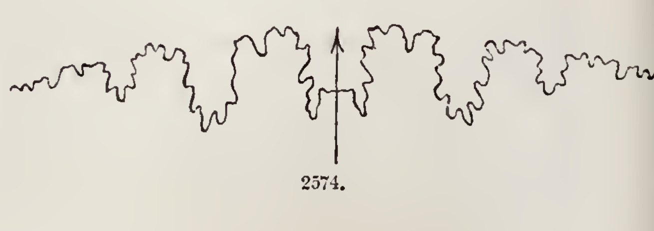
2576.—Baculites vertebralis.



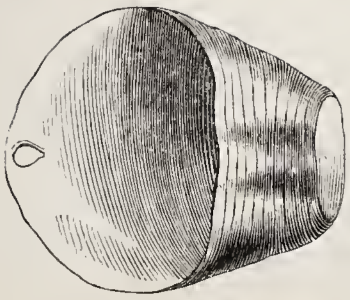
2572.



2571.

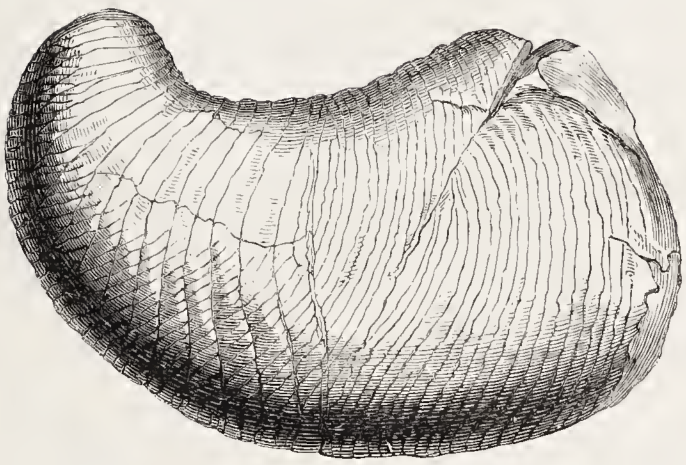


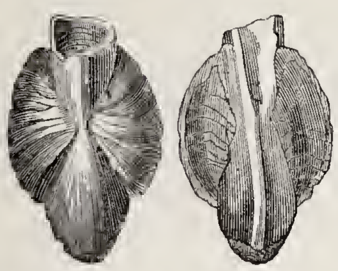
2574.

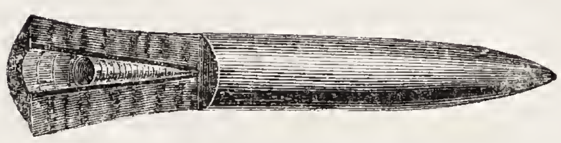

2580.—Cyrtoceras depressum.

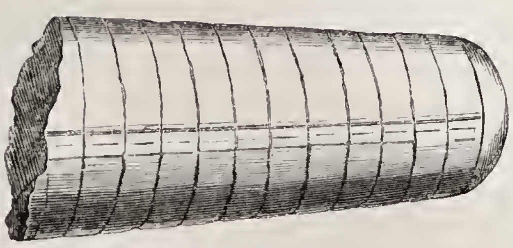

2581.—Lituites articulatus.


2583.—Phragmoceras ventricosum.


2582.—Phragmoceras ventricosum.


2585.—Beloptera belemnoidea.


2578.—Belemnites canaliculatus.


2579.—Orthoceras laterale.


2584.—Beloptera sepioidea.

kajak in the very seas which the clio itself navigates.

The outer covering of the clio is a delicate semi-transparent soft skin which covers a second tunic. This last is thicker, and presents longitudinal and very sensible muscular fibres, which come from two principal bundles attached to the sides of the neck. The effect of these fibres must be to shorten the general envelop of the body, and to approximate its form to a spherical shape. Cuvier, who gives the above description, adds, that he knows not with what the interval between this fleshy tunic and the mass of the viscera is filled in the living state; but observes that it is certain that these do not occupy the half of the area which the tunic incloses: and conjectures that there may be a liquor diffused there, or perhaps only a quantity of air which the animal can compress at pleasure when it would sink in the water, and dilate when it would rise.

The head of the clio is enveloped in a sort of hood, which can be opened and retracted at pleasure, so as to expose the mouth surrounded by three conical appendages on each side, like little fleshy tentacula. Examined by means of a microscope, each of these appendages is seen to be regularly and numerously covered with red points, which, when inspected through a lens of great power, are found to be distinct transparent cylinders, each sheathing about twenty minute suckers, which are capable of being protruded, and acting as organs of firm prehension. It has been calculated that the total number of these suckers upon the conical appendages of a single clio amount to three hundred and sixty thousand.

Besides these oval appendages, the clio can protrude from its head through a perforation in the centre of each valve of the hood two slender horns or feelers, in order to ascertain the presence of food.

The mouth of this little creature is a triangular orifice, armed according to Eschricht with two jaws with sharp horny pectinations fixed on a fleshy base. These pectinations are of unequal length, but their points are nearly on the same level, and they can be protruded for the purpose of seizing prey. Within the mouth is a tongue with its tip and upper surface covered with minute curved hooks in regular rows, evidently serving to assist in the act of deglutition.

With respect to eyes Cuvier says "some naturalists attribute these organs to them," and De Blainville has expressly described them. They are two in number, placed on the back of the neck, and though excessively minute appear to have a very complete structure.

Cuvier regarded the oars of this animal as its aerating as well as locomotive organs, but the correctness of this opinion is denied by Eschricht; in fact we are not only in ignorance as to the laboratory in which the circulating fluid undergoes its requisite purification, but also with respect to several other details in the economy of this mollusk.

The digestive apparatus is simple; there is a large liver; and there are also long slender salivary glands.

The clio borealis, though not more than an inch in length, forms the chief part of the food of the huge Greenland whale,—and under the name of "whales-food" is well known to the sailors who chase this huge tenant of the ocean. The clio dwells in shoals so countless and extensive that the surface of the water for a vast distance often seems alive with them, as they sport and gambol heedless of their destroyer, who, as he passes through their ranks, "thick as autumnal leaves in Valombrosa," opens his mouth and engulfs thousands at a snap.

Sir E. Parry found the clio in astonishing abundance in all parts of Baffin's Bay and Davis's Strait in the neighbourhood of ice. Captain James Ross observed it very numerous in most parts of the Arctic ocean, but less abundant in Regent's Inlet and the Gulf of Boothia. When the weather is calm these animals come in myriads to the surface for the purpose of respiration, but scarcely have they reached it when they again precipitate themselves towards the bottom.

A, Clio borealis, view of the back; *a*, the body; *b*, the viscera, seen through the common integuments; *c*, the tubercles of the head, and the holes wherein the three tentacula on each side are withdrawn; *d*, *d*, gills and fins. B, the same, view of the belly; *a*, *c*, *d*, indicate the same parts as in A; *e*, the two tentacula placed before the mouth. C, the same laid open; *c*, *d*, indicate the same parts as in the two former figures; *f*, *f*, the external tunic or skin; *g*, *g*, the internal tunic or fleshy pannicle; *h*, *h*, the principal bundles of its fibres; *i*, the mass of viscera; *m*, the principal vein of the fins.

We may pass from Clio to the Hyalæidæ of Cuvier (family Thecosomata, order Aporobranchiata of De Blainville).

The general characters of this family may be summed up as follows:—Animal furnished with a head, but it is not distinct; a third natatory membrane exists on the ventral region, it is small and intermediate between the two large fins. The mouth is situated in a cavity formed by the union of the locomotive organs. Shell nearly always present, but very variable in form.

2587, 2588.—THE CYMBULIA

(*Cymbulia Peronii*). Cuvier describes the Cymbulia as having a cartilaginous or gelatinous envelop in the form of a boat or slipper, beset with points in longitudinal rows; and the animal itself as possessing two great wings which are at once branchiæ and fins, and between on the open side a third smaller lobe which is three-pointed. See Fig. 2587; *a*, *a*, the fins; *b*, the intermediate lobe; *i*, the viscera seen through the shell. The mouth, provided with two small tentacula, is placed between the wings towards the shut side of the cell, and above are two small eyes. The transparency of the texture permits the internal organs to be distinguished with great facility. The shell is cartilaginous, translucent, oblong, in the form of a slipper, and entirely covered with a delicate and scarcely visible membrane. M. Rang observes that this curious and very incompletely known genus contains only a single species (1829), which is found in the Mediterranean Sea; and he adds that he only knows it from a drawing communicated to him by Cuvier, who in his 'Règne animal' remarks that in the figure given by M. de Blainville ('Malacologie') the animal is placed in the shell the wrong way; and that his (Cuvier's) description rests on recent and repeated observations made by M. Laurillard. M. Deshayes confirms this remark as to the inverse position of the animal, and says that he has had occasion to verify it often. M. Deshayes in his edition of Lamarck (1836) enumerates five species. That known to M. Rang was the C. Peronii. Fig. 2588 exhibits three figures of cymbulia in three different aspects:—*a*, the animal in the shell, seen from above; *b*, the shell seen edgeways; *c*, the shell seen from above.

2589.—THE SPIRATELLA

(*Spiratella limacina*, Blainville). Limacina arctica, Cuv.; Clio helicina, Phipps and Gmelin; Argonauta arctica, Fabricius.

The spiratella is a curious little animal, the body of which is elongated anteriorly, and turned into a spiral form behind; branchiæ in the form of plaits on the back; mouth furnished with two small appendages, which are united by one of their extremities to the anterior border.

Shell very delicate, fragile, vitreous, spiral, not carinated, turning rather obliquely on itself, with a circular aperture and simple borders. (Rang.)

Cuvier is of opinion that the Limacinæ ought, according to the description of Fabricius, to bear a strong relationship to Pneumodermon; but their body is terminated by a tail, which is twisted spirally ('contournée en spirale'), and is lodged in a very delicate shell, of one whorl and a half, umbilicated on one side and flattened on the other. Cuvier adds that the animal uses its shell as a boat and its wings as oars when it would swim on the surface of the sea. The same author remarks, that the only species, Clio helicina of Phipps and Gmelin, is scarcely less abundant in the Icy Sea than Clio borealis [Clio], and is considered as one of the principal aliments of the whale. He observes that he does not know whether the animal figured by Mr. Scoresby, of which M. de Blainville ('Malacologie,' pl. xlviii. bis, f. 5) makes his genus Spiratella, is in reality, as M. de Blainville believes, the same animal with that of Phipps and Fabricius. M. Rang considers Spiratella of De Blainville as synonymous with Limacina, of which M. Rang states that but one species is known, and says that it would be interesting to have new accounts of it. He speaks of its inhabiting the North Sea, its prodigious abundance, and the possibility of its serving as food for the whales. Phipps mentions it as being found in innumerable quantities in the Arctic Seas, and describes its body as of the size of a pea, rolled up into a spire like a helix, and its ovate, obtuse, expanded wings as being greater than the body. The cut is taken from the figure of M. de Blainville, who founds his genus (which he places under his family of Pteropoda, between Atlanta and Argonauta) on the materials furnished by Mr. Scoresby, and considers his Spiratella as synonymous with Cuvier's Limacina.

Mr. G. B. Sowerby figures a Limacina (in his 'Genera of Recent and Fossil Shells,' and in the same number as that which contains Cymbulia) from Messina. He describes it as a thin, fragile, spiral, discoid shell, umbilicated on both sides, and carinated on the back and below, with a membranaceous lamellar keel; and he says that it has externally much the appearance of a very diminutive umbilicated nautilus.

M. Deshayes, in his edition of Lamarck, remarks that the Limacinæ, of which M. de Blainville formed his genus Spiratella, have in fact much analogy with the Cleodoræ; and that they are Cleodoræ whose shell is spiral, and not swimming gastropods, like the Carinariæ and Atlantæ. M. Deshayes goes on to state he has many individuals preserved in spirit, which he owes to the generosity of Dr. Fleming, that he has examined them with attention, and that they have not the projecting foot of Atlanta, nor a fin-like foot, but two lateral fins of the form of those of the Cleodoræ. He adds that they have no tentacles, and no eyes, but a mouth in the shape of a triangular slit at the summit of the angle which forms the fins. The shell is not closed by an operculum as that of Atlanta is. M. Deshayes is of opinion that the genus ought to remain among the Pteropods, where it was placed by Cuvier and Lamarck.

2590.—THE THREE-SPINED HYALÆA

(*Hyalæa trispinosa*, Rang.) In the genus Hyalæa the animal is globular or oblong, furnished with two lateral expansions more or less elongated backwards; the intermediate lobe of a semicircular form; two very short tentacles, hardly distinct, contained in a cylindrical sheath; the aperture of the mouth provided with two labial appendages; branchiæ pectinated, on each side, in a particular cavity.

Shell horny or vitreous, transparent, and fragile, in form of a slipper, straight or recurved, with an anterior opening, and split laterally, tricuspidated backwards. (Rang.)

M. Rang remarks that this beautiful and interesting genus, the anatomy of which has been made known by M. Cuvier and M. de Blainville, is perfectly distinct from those which approach it. He speaks of the Hyalææ as very small animals, spread over all the seas of the torrid zone, and a great part of those of the temperate zones, and of the occurrence of the same species on the most opposite points of the globe. He adds that the discovery which he had made of many species, one in a fossil state, had caused him to divide the Hyalææ into the two following groups:—

1. *Globulosæ.*—Shell subglobular, having the lateral slits nearly as long as itself, and the appendages placed very much backward. H. uncinata, &c. This group, he says, is the most numerous.

2. *Elongatæ.*—Shell elongated, having the lateral slits short and the appendages advanced. H. trispinosa, &c.

Cuvier describes Hyalæa as having two great wings, no tentacles, a mantle slit at the sides, lodging the branchiæ in the bottom of the fissures, and covered by a shell equally slit at the sides, the ventral surface of which is very convex, the dorsal flat and longer than the other, and the transversal line, which unites them behind, furnished with three pointed dentilations. In the living state, the animal projects by the lateral slits of the shell filaments more or less long, which are productions of the mantle. Cuvier concludes by observing that the species most known (Anomia tridentata, Forskahl; Cavolina natans, Abildgaardt; Hyalæa cornea (tridentata), Lamarck) has a small yellowish demi-transparent shell, which is found in the Mediterranean Sea and in the ocean.

M. de Blainville, who has published a monograph of this genus in the 'Journal de Physique,' and in the 'Dictionnaire des Sciences Naturelles,' states that it contains already (1825) from five to six species, all of which appear to be the inhabitants of warm climates. He considers the genus Glandiolus of De Montfort as belonging to the Hyalææ, and quotes the observation of M. Defrance to that effect with approbation.

M. Deshayes enumerates sixteen recent species, exclusive of Hyalæa cuspidata, which, he says, is not a true Hyalæa, as Bosc, De Roissy, and Lamarck believed, but a Cleodora. MM. Rang, D'Orbigny, Lesueur, and Quoy and Gaimard, have principally contributed to the number of species.

Referring to Fig. 2590,—*a* represents the fins; *b*, the intermediate lobe; *c*, the mouth; *e*, the lateral expansions of the mantle; *i*, the viscera seen through the shell; *h*, the shell.

2591.—THE TRIDENTATE HYALÆA

(*Hyalæa tridentata* of Forskahl and Gmelin); Hyalæa papilionacea, Bory de St. Vincent; Hyalæa cornea, De Roissy.

This species inhabits the Mediterranean and the warmer seas. Its size scarcely equals that of a small hazel nut. Referring to Fig. 2591,—*a* represents the anterior border of the animal, showing the mouth.

2592.—THE PYRAMIDAL CLEODORA ?

(*Cleodora pyramidata*). Cuvier remarks, that the Cleodoræ, for which Brown originally founded the

genus Clio, appear analogous to the Hyalææ in the simplicity of their wings and the absence of tentacles between them; their conic or pyramidal shell, he adds, is not slit on the sides; and he quotes M. Rang's genera and subgenera.

M. Deshayes, in his edition of Lamarck, states that the Cleodoræ are much more allied to the Hyalææ than the Clios, approaching the former not only in having a shell, but also in the form of the animal, which bears a great resemblance to that of Hyalæa. It is not astonishing, proceeds M. Deshayes, that Lamarck, who had approximated the Cleodoræ to the Clios, should regard them as not very closely related to the Hyalææ; for, when he wrote, but a very small number of species were known, and he could hardly foresee that the assiduous researches of MM. Quoy and Gaimard, Rang and D'Orbigny, should have contributed to throw so much light on the Pteropods in general, and the Hyalææ and Cleodoræ in particular. If we have before us a sufficient number of species belonging to the two last-named genera, we shall see them blend into each other so as to make it impossible to draw the line between them. It is thus, continues M. Deshayes, that we proceed by insensible degrees from the globular to the lanceolate species.

The following is M. Rang's definition of Cleodora:—

Animal of an oblong or elongated form, furnished with an intermediate demicircular lobe, but having no lateral expansions; mantle open in front; branchiæ incompletely known.

Shell fragile, vitreous, in form of a sheath or case (gaîne ou cornet), more or less pointed posteriorly; aperture very large, nearly always without a slit, and without lateral appendages.

The same zoologist having, as he states, obtained many new species, and studied their organization, divides the genus into the following subgenera:

1. Cleodoræ properly so called.

Animal of an oblong form, having the mantle very much dilated and advanced on each side.

Shell pyramidal, angular, very much dilated anteriorly, with a very large aperture, canaliculated on each side, and rarely slit.

M. Rang makes this subgenus comprise (1829) five species only, two of which he considers as very doubtful. Type Cleodora lanceolata.

Description.—Shell compressed, elongated, lanceolate; aperture dilated.

Locality, the seas of warm climates.

M. Deshayes, in his edition of Lamarck, records thirteen species, besides Hyalæa cuspidata.

Referring to Fig. 2592,—*a* represents the animal and shell; *b*, the shell seen edgeways; *c*, the shell seen from above.

2. Cresis. (Rang.)

Animal very slender; the mantle not dilated on its sides; fins generally rather small.

2593.—THE CRESIS.

Shell very slender, fragile, and diaphanous, in the form of a straight or curved case (cornet), with an aperture almost always as large as the shell itself, and generally without a canal; no lateral appendages. M. Rang, who gives this description, says, that he formed this subgenus for some very small new mollusks, which he frequently met with in the middle of the ocean, and to which he unites, by analogy, the genera Vaginella of Daudin, and the Gadus of Montagu, known in the fossil state; and M. Rang reckons nine species.

Referring to Fig. 2593,—*a* represents the fins; *b*, the intermediate lobe; *c*, the mouth; *i*, the viscera seen through the shell; *h*, the shell.

A closely allied form has received from M. Rang the name of Cuvieria (see Fig. 2594), characterized by the animal being elongated, furnished with two rather large fins, and with an intermediate demicircular lobe: the exterior branchiæ situated at the base of the intermediate lobe; mouth furnished with dentiform pieces adapted for mastication.

Shell in the form of a cylindrical case, rather flattened near its aperture, which is heart-shaped, with sharp edges. The species on which M. Rang has founded the genus Cuvieria is a curious little mollusk, common in the Indian Seas, the ocean, and the South Sea.

From the perplexing forms which constitute the Pteropodous Mollusks, and which, however curious they may be from their structure, are interesting rather to the naturalist than the general reader (their habits and manners being, indeed, necessarily but little known), we shall pass to another great division or class of the mollusks, termed by scientific writers, generally, Gasteropoda, or Gastropodous Mollusks, from the circumstance of the under surface being modified into a fleshy disc for the purposes of locomotion, as we see in the snail or slug.

CLASS GASTEROPODA

(GASTROPODOUS MOLLUSKS, as Slugs, Snails, Whelks, Cowries, &c.). The Gastropods, or Univalve Mollusks, present us with a tolerably high grade of organic structure; far higher than is found in the subsequent class of Bivalve Mollusks, viz. Oysters, Mussels, &c. The nervous system, for example, is more concentrated, the viscera are more elaborate; the head is distinct, and contains a large nervous ganglion; it is furnished also with retractile organs, viz., tentacula, or horns, which are not only instruments of touch, but which often bear upon them the eyes. There is a mouth furnished with teeth, and also with a tongue; and the sense of taste is very acute. It would appear, moreover, that though no apparatus has been detected, the sense of smell is not altogether wanting.

The gasteropoda, as they are endowed with senses which open to them much of the world around them, so are they gifted with according powers of locomotion. As we have said, the title gastropod is given in allusion to the character of their locomotive organ; for the under surface of the body is converted into a sort of foot, with a fleshy disc beneath, on which they creep along by means of the expansive and contractile movements of which it is composed.

The common garden snail is an instance in point; if we watch a snail crawling upon a window pane, on the opposite side of the glass, the muscular working of the disc may be easily seen.

Unlike the bivalve-shelled mollusks, the gastropods comprise both aquatic and terrestrial groups; some are formed for the respiration of air, others of water; and it is curious to find that some species which tenant the water, as Limnæus, Planorbis, &c., breathe air, and come to the surface to respire.

All the bivalve-shelled mollusks are housed; not so the gastropods. The slugs have no shell, or at most a minute plate imbedded in the short contracted mantle covering the anterior part of the body above.

In Testacella, the mantle, which is minute and at the posterior part of the body below, is protected by a little oval shield.

In many marine species, as Doris, and some allied, and the Phyllidia, there is no shell at all. Others, however, have an ample shell, into which the animal can withdraw itself at pleasure; as the Helix, the Limpet (Patella), the Conch, &c.

The shell, secreted by an ample membrane, varies infinitely in shape, in compactness, and other particulars.

A general view of the mode of formation of the shells of these animals may not, perhaps, prove uninteresting, the more so as it is a subject not commonly understood.

It may be here, then, observed that shells differ in their composition (and the same observation applies to those of the bivalved or acephalous, that is headless, mollusks also). In some, as the conch and others (and the oyster among the bivalves), the carbonate of lime, with a superabundance of animal gelatine, is deposited in layers, a fine membrane interposing between each layer. Hence shells of this composition are termed membranous, and the solution of the lime by means of acids will leave the membranes perfect, but soft, having lost the earthy matter which gave them hardness. Moreover, on exposing these membranous shells to a red heat, they emit a strong fetid odour of burning animal matter, and fall to pieces.

Other shells, as the cowry, present us with a much more uniform composition and compact texture. In these shells, which are termed porcellaneous, the animal gelatine is in little quantity; and the particles of lime are more equally blended with it, not in layers, but assuming a more or less crystalline arrangement; the minute crystals presenting the form either of rhombs or prisms. Porcellaneous shells when exposed to the action of fire lose their colour, and give out but little smoke or odour, while they retain their form. On the contrary, they are almost entirely dissolved by the action of acids. These shells are far more brittle than the membranous shells, and also more transparent; and when this brittleness and transparency are very great, they have been termed vitreous, from their resemblance to glass.

The inner lining of most membranous shells, of a white, roseate, or other tint, and with a smooth polished surface, is called the nacre, or mother of pearl, and it is from the arrangement of the nacre in regular layers, effecting a series of exquisitely minute ridges or grooves, not unlike, when viewed through a microscope, the striæ on the cuticle at the pulpy tips of the fingers, that in so many membranous shells we see the nacre iridescent with rainbow tints, the light being reflected at different angles. In the lining of the fresh-water mussels, and especially in Haliotis, the nacre is very resplendent.

Most, if not all membranous shells are covered externally with an outer skin, or membranous epidermis, which most collectors are anxious to remove; in conch, which has a tough thick epidermis, we generally find that it has been carefully obliterated, to render the appearance more attractive.

The shells of the mollusca are the production of a portion of the animal termed the mantle (Pallium), and hence, according to the extent and figure of the mantle, and its temporary developments, will be the figure and general characters of the shell.

If we take a common snail, or helix, and remove it from the shell (killing it previously by immersion in boiling water), we shall find, on examining the animal, that the whole of the spiral portion, which was lodged in the upper whorls of the shell, is invested with a thin membrane, viz., the mantle. The anterior part of this mantle, on what may be called the back of the mollusk, is considerably thickened, swelling into a portion called the collar. This collar is provided with glands regularly arranged for the deposition of colouring matter, and as well as others for the secretion of lime and gelatine, in order to add to the shell as is needed. It is the smooth and thin portion of the mantle that secretes the nacre; but, as we have said, the collar of the mantle secretes the layers by which the growth of the shell is effected. If, as in the conical-shelled limpet, the collar of the mantle regularly deposits fresh material around the edge of the aperture in equal quantity layer after layer, then the shell will grow in one direction only, the diameter of the mouth enlarging, according to the extension of the collar of the mantle. It mostly, however, happens, that the mantle of these mollusks does not proceed with its work equally on all sides; indeed, the mantle does not, as in the limpet, hang over the animal in a tent-like manner, but has its margin across the back; hence it adds only to the edge, and not to the convex side which forms the posterior boundary of the opening. In this case, as in planorbis, the increase of the anterior margin tends to the formation of a spiral shell, the coils being all on one plane.

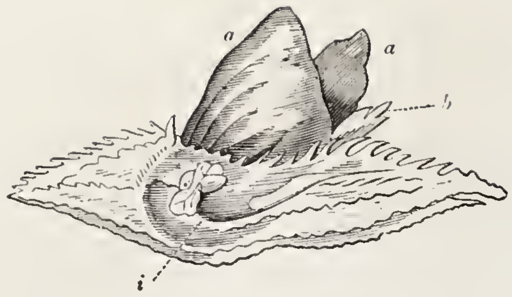
Most commonly there is a preponderance of development (from the form of the collar), laterally as well as forwards, and then, as in the helix, a spiral or turbinated shell will be the result. If we take a whorled shell in our hand, we shall find that the turns of the whorl are directed from left to right; and this results from the situation of the heart and great blood-vessels relatively to the shell, these being placed on the left side; the left side of the mantle therefore is more active than the right, so that the vis a tergo is from the left, forcing (if we may so speak), towards the right. Occasionally we see a shell whorled in a contrary direction, the situation of the organs, and figure of the body, being reversed; such shells are termed sinistral; they are not common.

The axis of the gyration of the whorls of shells is termed the columella, and on dividing a shell longitudinally, as the whelk for example, the columella appears like the pillar or modiolus of winding stairs in a tower or steeple; round which the whorls are wound. The edge of the aperture to which the columella advances is termed the columellar lip: looking on the back of the shell it is on the left hand posteriorly.

Instances occur in which the mollusk, for the sake of convenience, removes portions of the interior whorls as it increases in growth; the cone thins by some process the inner whorls, and the auricula, which inhabits marshy places, obliterates them in its progress of growth.

In many shells, as Pterocera, and various species of Murex, as Murex regius, and Murex tenuispina, we observe spines, or rows of antler-like projections, at regular distances apart; now these are formed by the collar of the mantle, which, at definite intervals, during the growth of the mollusk becomes temporarily developed in a peculiar manner, shooting out into processes secreting shelly matter, which encases, or nearly encases them. When spines are produced, as in Murex tenuispina, the slender processes of the mantle are encased in the shelly matter; to this a lining of nacre is added layer after layer, the process of the mantle retiring more and more, till in due time the cavity of the spine is obliterated, and the process of the mantle retracted or absorbed. Where branches like antlers are produced, these will be found to be more or less like troughs or canals, hollowed beneath, the under surface of the extensions of the mantle not secreting shell.

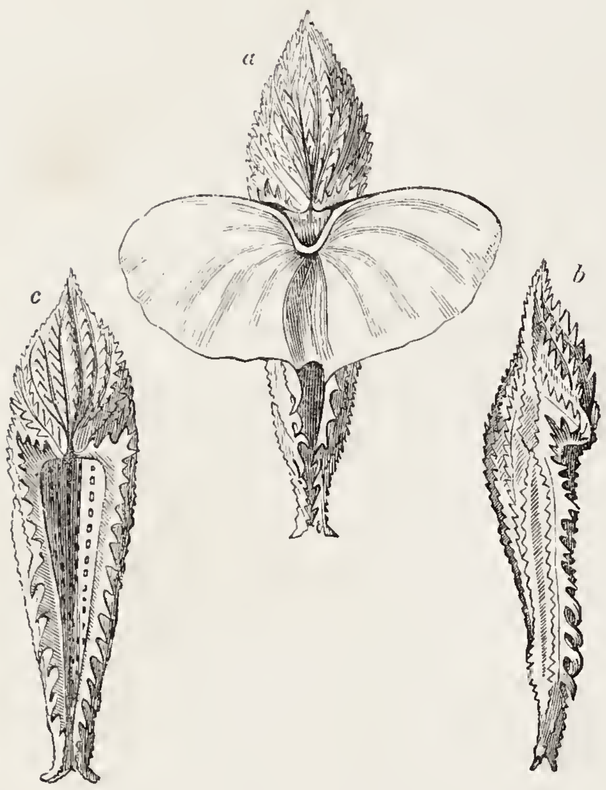
In the Cowry (Cypræa) the formation of the shell is very curious; and, indeed, so greatly does it differ in its young and perfect state, that no one would at first suppose the two to be generically, much less



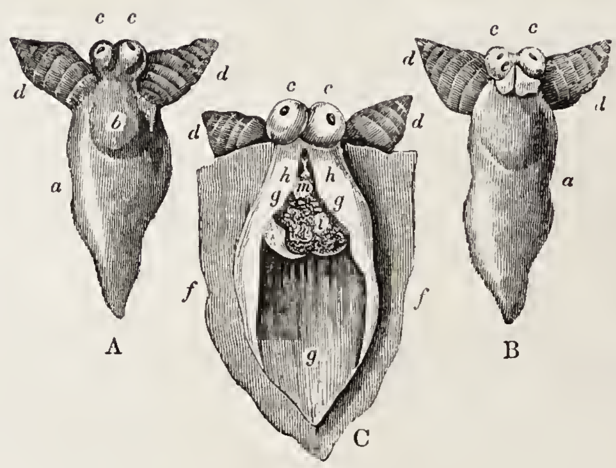
2587.—Cymbulia.

2591.—Tridentate Hyalæa.

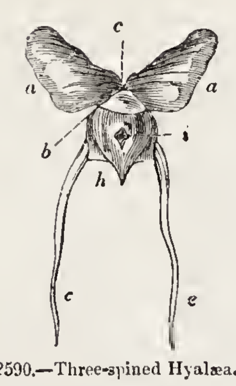
2589.—Spiratella.



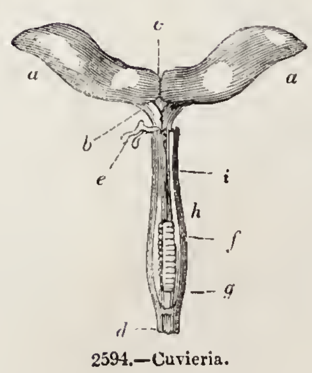
2588.—Cymbulia.



2586.—Polar Clio.

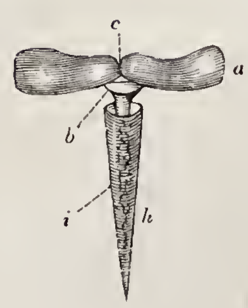


2590.—Three-spined Hyalæa.

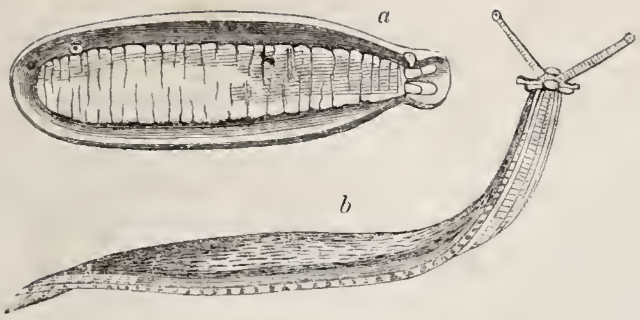


2594.—Cuvieria.

2592.—Pyramidal Cleodora.

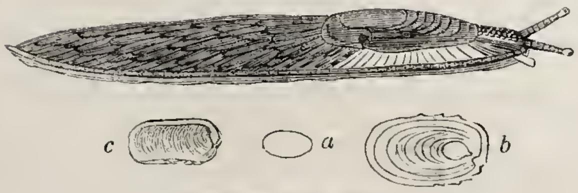


2593.—Cresis.



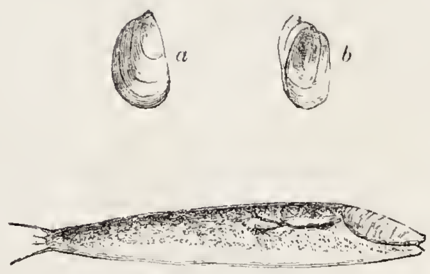
2597.—Shielded Slug.

2595.—Red Slug.

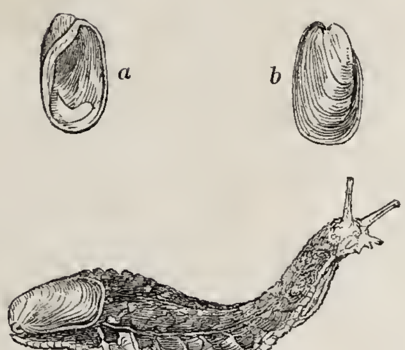


2596.—Great Grey Slug.

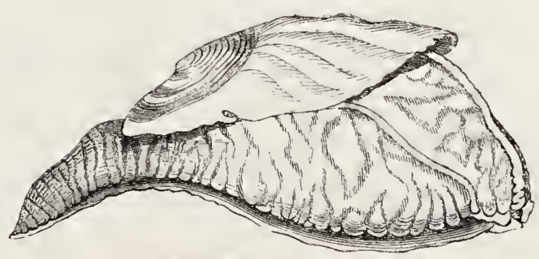
2598.—Limacella.



2599.—Testacella.



2600.—Teneriffe Testacella.



2601.—Olivier's Parmacella.

2603.—Lamarck's Carocolla.

2602.—Large Garden Snail.

specifically, identical. We have already instanced the cowry as having a porcellaneous shell. The shell, at first, instead of having its lips rolled inwards and toothed, with the aperture narrow, much resembles the olive shell; the substance is thin, and the colour dull and opaque, and the outer edge, instead of being rolled inwards and thick, is sharp. But a change occurs; the mantle begins to be reflected on each side round the shell, covering it externally. The lip curves inwards, the teeth appear, and beautiful markings are beginning to show themselves. At length the shell is thickened by repeated layers of porcellaneous matter, the colours are vivid, and the spire is completely hidden. If we take the shell of a cowry, and look at it, a line down the centre of its back will be seen marking the place where the two reflected expansions of the mantle met each other.

Among the most singular of the univalve shells, is that covering the Chiton, and which forms an exception to the turbinated or whorled character which most exhibit. On examining these slug-like creatures, we find the back covered with a tough leathery mantle, which extends considerably beyond the body of the animal beneath. On the top of this mantle, are eight transverse plates of shell, usually overlapping each other like the slates of a house, but never reaching to the edges of the mantle: these free edges have patterns of different insculpture according to the species.

In many instances, among aquatic species, the entrance of the shell is closed when the animal is withdrawn by means of a horny or calcareous plate, termed the operculum, and which is attached to the portion of the foot last withdrawn. It fits the entrance precisely, and shuts the mollusk in; protecting it from the assaults of enemies. The periwinkle is a familiar example.

The operculum is, however, sometimes a lid attached by a hinge to the columellar portion of the lip, and may be regarded as a distinct valve or, as it is called, a clausium, which may be defined as a modified operculum, attached by an elastic hinge to the columella; and which shuts spontaneously when the mollusk retires within. The membrane, with which the common garden snail and others shut themselves in while hybernating in holes of trees or walls, or under the roots of hedges, or even attached to palings, &c., during winter, is termed the epiphragma. It appears to be indurated mucus, secreted for the occasion.

Gastropodous mollusks have the power of repairing their shells; if, for example, a portion of the shell of a common snail be removed, without injuring the animal, which may be easily effected, in twenty-four hours a pellicle will be found extended across the vacant space, but beneath the level of the edges of the fractured part: this pellicle is thickened by additional layers, till it has acquired nearly the thickness of the original shell; the whole process occupies about a fortnight. The repaired part is very distinct, as it is not by a growth of the edges, but by the affixing a plate from within to block up the aperture occasioned by the removal of a portion, that the injury is repaired.

Various are the systems of arrangement adopted by naturalists, with respect to the present great group of mollusks, but as it is far from our design to enter into the "deep things" of science, we shall merely give a brief review of that of Cuvier. He divides the Gastropoda into nine orders, according to the characters presented by the respiratory system, viz:—1, Pulmonobranchiata; 2, Nudibranchiata; 3, Inferobranchiata; 4, Tectibranchiata; 5, Heteropoda; 6, Pectinibranchiata; 7, Tubulibranchiata; 8, Scutibranchiata; 9, Cyclobranchiata.

1. The Pulmonobranchiata, of which the slug, the snail, the Limnæus, and Planorbis, &c., are examples, are distinguished by respiring atmospheric air, which is alternately drawn into and expelled from a cavity lined with a most delicate vascular network: the respiratory organ opens on the right side of the body near the margin of the shell, below the collar of the mantle; and it may be further stated that the muscular floor of this cavity performs movements analogous to those of the diaphragm in quadrupeds. Of these air-breathing mollusks, some are terrestrial, others live in streams, or in sluggish or stagnant waters; and we may here add, that of the aquatic forms, some at least, as Planorbis, are organized to respire both air and water; of this section some are shelled, others naked.

2. The Nudibranchiata are marine mollusks destitute of a shell, as Doris, Tritonia, Glaucus, &c. They have no pulmonary cavity; and the branchiæ are exposed on some part of the back. In the Doris, which swims reversed, the foot appearing uppermost like a boat, the branchiæ are flower-like, and radiate very beautifully at the end of the back.

3. The Inferobranchiata, as Phyllidia, have no shells, and their branchiæ, like two long rows of leaflets, are placed on each side of the body, under a projecting edge formed by the mantle.

4. Tectibranchiata, as Pleurobranchus, Aplysia, Dolabella, &c., have the branchial fringe or leaflets placed under the margin of the mantle on the right side only. The mantle contains almost always in its substance a little shell.

5. The Heteropoda are so named because their foot, instead of forming a horizontal disc, is compressed into the form of a vertical muscular oar, on the edge of which generally is a dilated part hollowed out, representing the disc in other orders; the branchiæ form tufts on the hinder part of back. These mollusks swim with the back downwards, and the vertical foot upwards, and are enabled to distend themselves by filling the body with water.

6. The Pectinibranchiata form beyond comparison the most numerous division of the Gasteropoda. This order in fact includes all the inhabitants of spiral or whorled univalve sea-shells: their branchiæ are comb, or gill like and are placed in one, two, or three rows, suspended from the roof of a branchial chamber, in the body of the animal, contained within the widest or last formed whorl of the shell. This chamber opens by a wide orifice or by a siphon which admits the sea-water. The sexes are distinct.

7. Tubulibranchiata. From the Pectinibranchiata has been separated a group termed Tubulibranchiata from having the branchiæ in a tubular cavity. The animals of this group, as Vermetus and Magilus, inhabit long irregular shells spirally contorted, and often twisted in a serpentiform manner with each other, or with various objects.

8. Scutibranchiata. The Scutibranchiata, as Haliotis, or sea-ear, and Fissurella, &c., agree with the Pectinibranchiata in the general characters of the branchiæ; but they inhabit very open shells which cannot be called turbinated; and there are other points in their economy which render it at least convenient to separate them into an order by themselves.

9. The Cyclobranchiata, as the Patella, or Limpet, and the Chiton, have the branchiæ forming a fringe around the body of the animal under the edges of the mantle.

We have already alluded to the senses with which the gastropods are endowed; and here we may add as respects the eyes, that they are sometimes seated on the head, sometimes on the top of the tentacles or horns, and sometimes at their base. In the common snail there are two eyes seated each on one of the larger horns or tentacles. In these animals the horns are four in number, and retractile. In the marine gastropods, the tentacles are mostly two in number, and often not retractile, and the eyes are usually seated at their base. In the fresh-water pulmonobranchiata, there are only two horns; they are retractile, and the eyes are on their inner base, as in Planorbis, Limnæus, Physa, &c.

In the chiton, one of the cyclobranchiate marine gastropods, there are neither eyes nor tentacles.

The retractile horns of the snail are organs of touch, especially the two lowermost or shortest, the two uppermost being, as we have said, furnished with eyes. They are supplied with nerves from the great supra-œsophageal ganglion; are hollow or tubular; and their retraction is effected by a muscular slip, which inverts them like the finger of a glove, the tip being gradually drawn down from within. When thus inverted they lodge in a cavity for their reception. The protrusion of the horn is effected by means of a system of circular muscular fibres composing the walls of the cavity of lodgment and also of each tubular tentacle, which by their contraction force out the inverted portion, and having accomplished this, in conjunction with longitudinal fibres give it firmness and mobility. Now it would appear that the nerves which run up the tentacle must be stretched when the latter is extended, but such is not the case; nerves do not admit of such rude treatment without pain and loss of functional power; the provision is simple, the nerve (whether of sight or feeling) is as long as the tentacle extended to its uttermost, and when the tentacle is inverted it is thrown into series of coils lodged in the cavity into which the tentacle is drawn. Very variable, according to the nature of the food, is the structure of the mouth in the gasteropoda. In the snail and its allies the mouth is placed on the under part of the head, and is furnished with an instrument well adapted for cutting leaves and fruits. The oral cavity, which is muscular, has affixed to its upper part a horny plate, the lower edge of which is free, extremely sharp, and dentated, and well adapted for dividing the soft parts of vegetables, to which it is applied; the floor of the oral cavity is provided with a small tongue of a cartilaginous texture, with its surface transversely striated; and by its action it propels the food into the gullet. Snails and slugs are the pests of the garden: but slugs, as the ordinary slugs, are very partial to animal food, and when the dog has left a half-picked bone on the grass-plot, we have found it covered with slugs at work upon it; we have seen them also at work upon dead worms; and they appear to be guided in their search for food by the sense of smell.

In some, as Pleurobranchus (Tectibranchiata), and in Pterotrachea (Heteropoda), the mouth is a simple tube, destitute of teeth, but capable of seizing soft and minute substances.

A third kind of mouth is exemplified in the Tritonia (Nudibranchiata). It is of an oval form furnished with large fleshy lips, and a tongue covered with spines: within the lips are two lateral horny jaws resembling two sharp-edged blades, opposed to each other like those of a pair of shears, and in the same manner working upon an elastic hinge. These blades are acted upon by powerful muscles and cut hard substances with great facility. The spines on the tongue are recurved, and assist materially in propelling the food into the gullet.

A more complicated mouth is found in many of the Pectinibranchiata, as the Whelk (Buccinum). It may be described as a flexible proboscis, movable in various directions, and capable of being retracted, like the horns of the snail. To the end of this tubular proboscis, the tongue and also the gullet are both carried out; the tongue is cartilaginous, and moreover supported by two cartilaginous slips, of which the extremities form a sort of double lip, capable of being opened and closed, and the cartilages can be moved upon each other by the action of muscles; now the tongue is armed with sharp, hard, hooked spines, and when it is applied to any shell which the animal desires to drill for the purpose of sucking out the contents, the supporting cartilages by their movements alternately elevate and depress the spines, which rasp away on a small surface, and soon pierce through the substance. Perhaps in this operation the saliva, which is carried by long ducts to the tongue, may assist by some solvent quality it possesses; but although this is probable, it is not positively ascertained. Certain it is, however, that with this slender rasp-like tongue, the whelk will pierce shells of great solidity for the sake of feasting on their unfortunate inmates.

The digestive apparatus of the gastropods varies in the different groups; but into this and other points of anatomical detail we forbear to enter. We must attend to our pictorial specimens.

ORDER PULMONOBRANCHIATA.

Family LIMACIDÆ (SLUGS).

These destructive pests in gardens and cultivated fields are too well known to need a detailed account of their external characters. Almost all have four tentacles, but Cuvier states that in two or three small species, the lower pair are wanting; the mantle, which is generally seen on the anterior portion of the back, behind the head, often contains a thin shell; sometimes only calcareous grains.

2595.—THE RED SLUG

(*Arion rufus*). Limax rufus, Linn. In this genus, the orifice of respiration is towards the anterior part of the mantle, and in the substance of the latter are small calcareous concretions; a mucous pore at the end of the tail.

The red slug is very common, and abounds in some gardens almost as much as the small grey slug, which it greatly exceeds in size. Its general colour is rufous, sometimes deepening almost to black. It is this species of which Cuvier says that in France, a decoction (bouillon) is used in diseases of the chest: in some parts of England we have known the small grey garden slugs swallowed in numbers by weak or consumptive persons.

2596.—THE GREAT GREY SLUG

(*Limax antiquorum*, Féruss.). Limax maximus, Linn. In the subgenus Limax, as established by M. Férussac, the respiratory orifice is situated more backwards than in Arion; and the mantle is marked with fine concentric striæ, and contains a minute shelly plate. At Fig. 2596, *a* represents the internal shell of the great grey slug; *b*, the same enlarged; *c*, the under view of the shell from another individual. There is no terminal mucous pore.

This is the largest British species; it is rugose above, of a greyish colour, with longitudinal dashes and lines of black. It frequents damp places, and often invades humid cellars, or outhouses. Another large species, the black slug (Limax ater), is well known, and is abundant along the banks of hedgerows, and amidst the grass of meadows, during the summer. It feeds on the leaves and roots of vegetables.

Certain slugs of the East and West Indies, constituting the genus Vaginulus of Férussac, are remarkable for having the mantle extended over the whole of the upper surface of the body, or even extending beyond it, and forming in front a sort of hood, beneath which the head can be withdrawn; there is no rudimentary shell, nor any calcareous concre-

tions in the mantle, nor is there any terminal pore. When extended these slugs are very slender, and it has been stated that they are both terrestrial and aquatic in their habits, but M. Rang observes that he never met with them in Bourbon and Martinique, except in the woods and gardens, under old fallen trunks. The following is an example.

2597.—THE SHIELDED SLUG

(*Vaginulus Taunaisi*). Onichidium læve, De Blainville.

The letter *a* exhibits the animal contracted and seen on the under side, with the head covered by the mantle; *b* exhibits the animal extended and crawling.

2598.—THE LIMACELLA

(*Limacella Elfortiana*). All we know of this slug is from M. de Blainville himself, who first characterized it, and who says that the combination of characters appears to him so anomalous that he doubts really whether he had well observed the mollusk on which he has established the genus. M. Rang however gives it a place in the family, merely copying the description and M. de Blainville's expressions of doubt above stated.

Generic character.—Animal elongated, subcylindrical, provided with a foot as long and as large as itself, from which it is separated only by a furrow; enveloped in a thick skin, forming at the anterior part of the back a sort of buckler for the protection of the pulmonary cavity, the orifice of which is at its right border.

2599.—THE TESTACELLA (*Testacella scutulum*).

2600.—THE TENERIFFE TESTACELLA

(*Testacella Maugei*). The Testacellæ are slugs, with a contracted mantle, placed over the hinder part of the back, and supporting a small external plate or shell, somewhat spiral in its contour, and of an oval outline. The tentacles are four; the orifice of the pulmonary cavity is placed under the right side of the posterior apex of the shell. Referring to Fig. 2599, *a* shows the shell externally, *b*, internally, of T. scutulum; and turning to Fig. 2600, *a* and *b* exhibit the shell of T. Maugei. Three species are described and figured by Mr. Sowerby, viz.: T. haliotideus, a native of France; Scutulum, considered by Mr. Sowerby to be a native of England; and Maugei, an inhabitant of Teneriffe, but now naturalized around Bristol.

The testacella appears to have been first noticed by M. Dugué, in a garden at Dieppe in 1740: but it does not seem to have attracted much attention till M. Maugé, some years since, brought home specimens from the island of Teneriffe. "It has also been found," says Mr. Sowerby, "in several parts of France, and in Spain, and more lately in a garden at Bristol. Some specimens from the last-mentioned place have been handed to us by Mr. Miller of that city. It feeds upon earth-worms, having the power of elongating its body to such a degree, that it is able to follow them in all their subterranean windings: we have observed them attentively, and were rather surprised that an animal generally so extremely sluggish in its motions, after discovering its prey by means of its tentacula, thrusting from its large mouth its white crenulated revolute tongue, should instantly seize upon with extraordinary rapidity, and firmly retain, an earth-worm of much greater size and apparent force than itself, but which by its utmost exertion is unable to escape." Mr. Sowerby adds, that De Férussac and Cuvier consider this to be the only carnivorous terrestrial mollusk. Slugs, however, as we have observed, are carnivorous.

De Férussac remarked that the simple, gelatinous, contractile mantle of the animal, hidden habitually under the shell, is divided into many lobes capable of enveloping the whole body by an extraordinary development, when the animal finds it necessary to protect itself from the consequences of too great dryness.

To this we may add, that in the gardens around Bristol, the testacella or shelled slug is now so common, as to prove a nuisance. It has been also found in a garden in Gloucestershire (see the 'Penny Magazine,' 1835, p. 152). Mr. Sowerby found the Testacella scutulum in a garden at Lambeth; and in our own garden at Hammersmith, this species (at least so we suppose it to be) is tolerably abundant; several specimens, some of considerable size, are now before us; the colour is yellow, more or less deep, sometimes of a straw tint, with a white line along each side. In crawling, these slugs greatly extend the anterior part of the body, to an acute point, and insinuate themselves with the utmost ease into the soil. Their texture is very firm, almost cartilaginous to the feel, and the mucus of the skin is extremely tenacious. They are most commonly to be found in cool and dewy or wet weather; and they appear abroad late in the season. The first we captured, or indeed saw, was on October the 29th, 1841. Whether these slugs exist in other gardens about the neighbourhood we cannot learn.

2601.—OLIVIER'S PARMACELLA

(*Parmacella Olivieri*). The parmacellæ are slug-like animals, having a mantle with free edges, supporting on its posterior portion an oblong flat shell, exhibiting the rudiment of a spire.

Olivier's parmacella is a native of Mesopotamia, whence a specimen was brought by that traveller to Paris, and served for the anatomical researches of Cuvier.

Other species are found in Brazil, Bourbon, Madagascar, and the East Indies. M. Rang states, that in Brazil these parmacellæ inhabit the woods, but that at Bourbon and Madagascar he never found them except upon rocks near fresh-water torrents.

Family HELICIDÆ (COMMON GARDEN SNAIL, BULINUS, &c.).

2602.—THE LARGE GARDEN SNAIL

(*Helix aspersa*). As the fisherman hates the otter, so does the gardener this voracious, destructive pest, the ravages of which, in the garden and orchard, are often really annoying. If the species be identical, this snail has a most extensive range. It is found, for instance, over a great part of Europe, Asia, and Africa, at the foot of Chimborazo, and in the forests of Guiana and Brazil. In our own island, it abounds in the southern and midland counties; yet we do not recollect ever to have seen it in Derbyshire, or in the portions of Staffordshire, Cheshire, and Lancashire with which we are well acquainted; and we doubt its existence in the north. In these counties the beautiful Belted Snail (Helix nemoralis) is abundant.

The Helix aspersa often attains to a very large size: we have specimens in which the mouth of the shell measures transversely seven-eighths of an inch. In winter, this snail becomes torpid, and closes the opening of the shell with a tough membrane (Epiphragma).

An allied, but larger species, le grand Escargot of the French (Helix pomatia), abundant in the warmer parts of the continent, has been naturalized in Surrey, and some other counties of our island. It is eaten on many parts of the continent, where, says Cuvier, it is "nourriture assez recherchée." This, and perhaps other species, formed a favourite dish with the Romans, who had their Cochlearia, or Snailleries (Escargotoires), where they were fattened upon meal and new wine, boiled down, and were sometimes brought to an enormous size. We cannot, however, help fancying that some error must have been committed in the text of a passage in the work of Pliny, who, on the authority of Varro, says, "cujus artis (*i. e.* of fattening snails) gloria in eandem magnitudinem perducta sit, ut octoginta quadrantes caperent singularum calyces." Now if the "quadrans" means a measure of three ounces (which is not very clear), we have an assertion, that the shells would hold two hundred and forty ounces, or ten quarts, which is positively beyond belief. Referring to this passage, and to Varro (de Re Rusticâ), Pennant says, "People need not admire the temperance of the supper of the younger Pliny, which consisted of only a lettuce a-piece, three snails, two eggs, a barley-cake, sweet wine and snow, in case his snails bore any proportion to those of Hirpinus."

Snails are fattened at the present day in many parts of the continent, in Escargotoires or Snailleries, which may be described as pens boarded in and abundantly supplied with herbs, with which the floor is covered to the depth of a foot.

Some curious circumstances attend the hybernation of the Helix pomatia, which have been detailed by M. Gaspard. He remarks that in our temperate climate, as soon as the first autumnal chills are felt, generally about the commencement of October, this species becomes indolent, loses its appetite, and associates in considerable numbers on hillocks, the banks of ditches, thickets, hedges, and similar places. In a short time they cease feeding, and then hide themselves under moss, grass, dead leaves, and the like. Here each forms for itself with the anterior part of its muscular foot a cavity sufficiently large to contain at least its shell: this cavity it enlarges and excavates by turning itself round on every side, then raising itself against the sides of the cavity, and at last against the roof formed of moss or leaves, or a small quantity of earth brought there by its motions. When it has succeeded in bringing the aperture of the shell to nearly a horizontal position, it stops. The foot is soon contracted within the shell, the snail then expands, so as completely to cover it, the collar of the mantle, which is at this period very white; and then inspires a quantity of air, after which it closes the respiratory hole. When this is done, a fine transparent membrane is formed with its mucus, and interposed between the mantle and any extraneous substances lying above. The mantle then secretes a quantity of very white fluid over its whole surface, which sets uniformly, like plaster of Paris, and instantly forming a continuous covering about half a line thick. When this is hardened, the animal separates its mantle from it by another and stronger mucous secretion; and after a few hours, expelling a portion of the air it had previously inspired, it is enabled to shrink a little farther into the shell. It now forms another lamina of mucus, expires more air, and thus retires farther into the shell. In this way sometimes a fourth, fifth, and even a sixth partition is formed, with intermediate cells filled with air. Such is M. Gaspard's account; but Mr. Bell remarks that it does not completely explain the manner in which the excavation is formed. "It is not by the pressure of the foot," says the last-named zoologist, "and the turning round of the shell, that this is principally effected. A large quantity of very viscid mucus is secreted on the under surface of the foot, to which a layer of earth or dead leaves adheres: this is turned on one side, and a fresh secretion being thrown out, the layer of earth mixed with mucus is left. The animal then takes another layer of earth on the bottom of the foot, turns it also to the part where he intends to form the wall of his habitation, and leaves it in the same manner, repeating the process until the cavity is sufficiently large, and thus making the sides smooth, even, and compact. In forming the dome or arch of the chamber a similar method is used, the foot collecting on its under surface a quantity of earth; and the animal turning it upwards, leaves it by throwing out fresh mucus, and this is repeated until a perfect roof is formed. As I have very often watched this curious process, I am certain of the facts. On removing very carefully a portion of the roof soon after its completion, I was enabled to see the formation of the operculum. In about an hour, or even less, after the hybernaculum is covered in, the whole surface of the collar of the mantle instantaneously pours out the calcareous secretion in considerable quantity. This is at first as fluid as thick cream, but very soon acquires exactly the consistence of bird-lime, being excessively adhesive and tenacious; and in about an hour after it is poured out it is perfectly solid."

M. Gaspard states that the labour of each individual continues for about two or three days; but that the whole of the month of October is occupied by the general closing of the shells of the species. He adds that about the beginning of April the hybernation ceases. "The mode by which their escape from confinement is effected is simple and easily comprehended. The air which is contained in the different cells, and which had been expired on the animal withdrawing itself farther and farther into the shell after the formation of the operculum, is again inspired, and each separate membranous partition broken by the pressure of the hinder parts of the foot projected through the mantle. When it arrives at the calcareous operculum, the animal, making a last effort, bursts and detaches its most obtuse angle. Then insinuating by little and little the edge of the foot between the shell and the operculum, it forces the latter off or breaks it away." (See the Abstract of M. Gaspard's Memoir, with notes, by T. Bell, F. L. S., 'Zoological Journal,' vol. i.)

The following shells are examples of various forms among the Helicidæ, and serve to show the variation of figure which this family exhibits.

2603.—LAMARCK'S CAROCOLLA

(*Carocolla Lamarckii*). The animal is represented in the act of crawling along.

Fig. 2604, the White-lipped Carocolla (Carocolla albirostris).

Fig. 2605, the Berry-like Pupa (Pupa uva).

Fig. 2606, the Chrysalis Pupa (Pupa chrysalis).

Fig. 2607, the Depressed Anastoma (Anastoma depressum). In two views.

2608.—THE CONTUSED STREPTAXIS

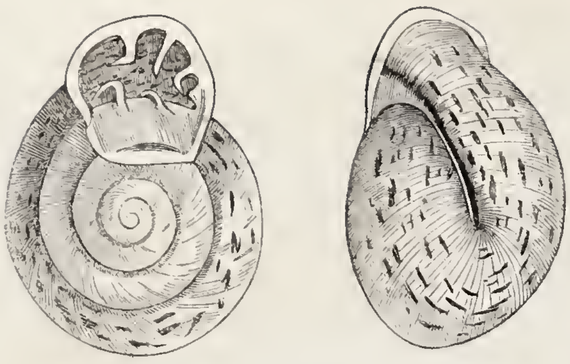
(*Streptaxis contusa*, Gray). The genus Streptaxis was first described by J. E. Gray, Esq., F.R.S., &c., in Loudon's 'Mag. of Nat. Hist.' Sept., 1837. The species inhabit the tropical parts of Africa and South America. Our figured specimen is a native of Brazil. It is seen in two views.

Fig. 2609, the Fragile Balea (Balea fragilis). Represented in two views.

Fig. 2610, the Eastern Partula (Partula australis). In two views.

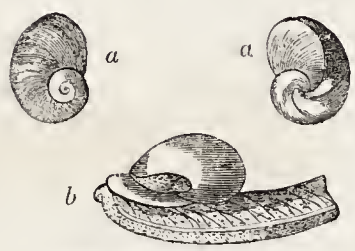
2611.—THE MINUTE VERTIGO

(*Vertigo pusilla*). In the genus Vertigo, established by Müller, the snail has only two tentacles or horns, with the eyes on the tips. The shells are sinistral. Of the two figures represented at Fig. 2611, *a* represents the Vertigo pusilla, *b* is an allied species with the animal. Both are magnified. Vertigo



2607.—Depressed Anastoma.

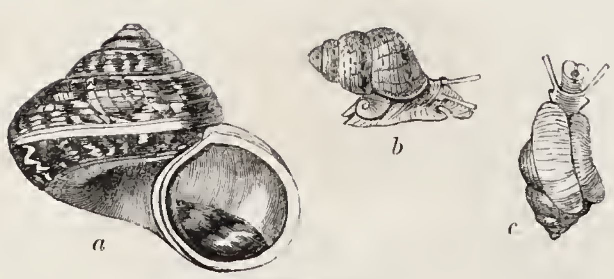
2611.—Minute Vertigo, magnified.



2616.—Cuvier's Helicarion.

2615.—Pellucid Vitrina.

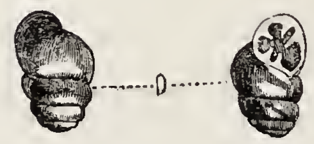
2617.—Glossy Bulinus.



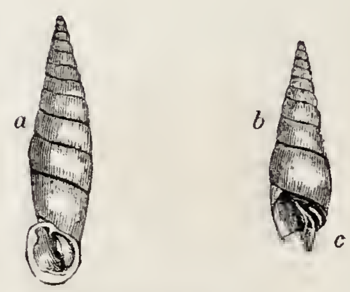
2614.—Cyclostoma.

2610.—Eastern Partula.

2608.—Contused Streptaxis.



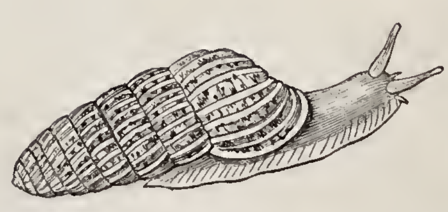
2612.—Minute Vertigo, magnified.



2613.—Clausilia.

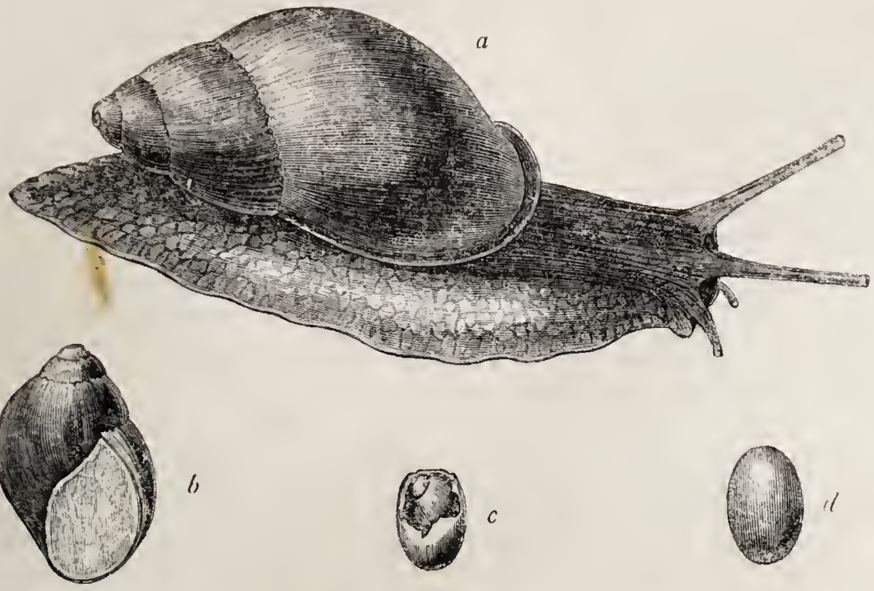
2609.—Fragile Balea, magnified.

2604.—White-lipped Carocolla.

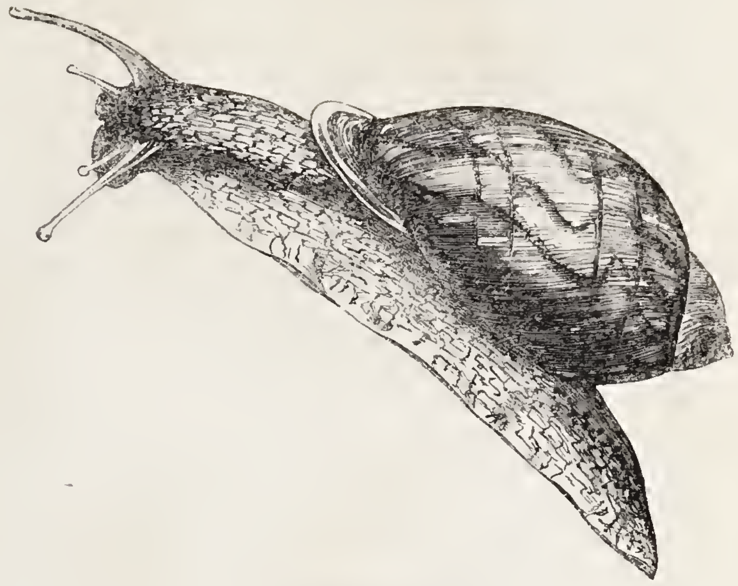


2605.—Berry-like Pupa.

2606.—Chrysalis Pupa.



2618.—Roseate Bulinus.

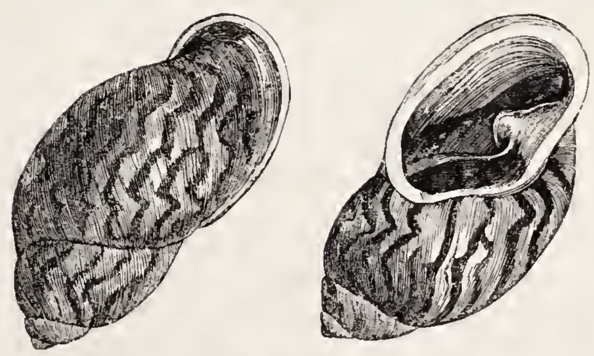


2621.—Undulated Plekocheilus.

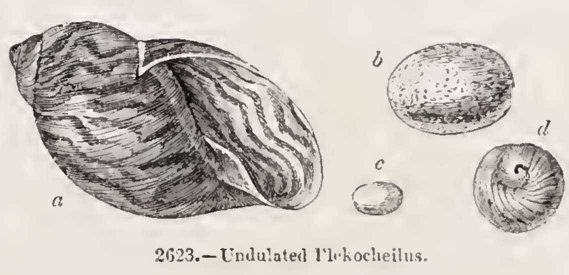
2620.—Three-banded Bulimulus.

2624.—Megaspira.

619.—Blood-lipped Bulinus.



2622.—Undulated Plekocheilus.



2623.—Undulated Plekocheilus.

pusilla is also represented at Fig. 2612, in two views, with the natural size given between the two figures.

2613.—THE CLAUSILIA

(*Clausilia Macascarensis*). The shells of this genus, Les nompareilles of Cuvier, are slender, long, and pointed; in the adults, the last whorl is contracted, compressed, and somewhat detached; the orifice is complete, with a thickened rim, and often dentelated. In the narrowed whorl is generally found a small sigmoid lamina, or clausium.

The Clausiliæ are of small size, and live on mossy banks, or at the foot of trees. Referring to Fig. 2613—*a* represents Clausilia Macascarensis; *b*, the same, broken, to show *c*, the Clausium.

2614.—THE CYCLOSTOMA

(*Cyclostoma*). Dr. Fleming, and the able writer of the articles on shells in the 'Penny Cyclopædia,' place the genus Cyclostoma among the Helicidæ, but Cuvier regards it as one of the Pectinibranchiata, where he also places the genus Paludina, of which the common Helix vivipara of Linnæus, abundant in our fresh waters, is an example.

The species of the genus Cyclostoma are terrestrial; the sexes are distinct. There are two tentacles, terminated by blunt tubercles, considered by Montagu as eyes, but the true eyes are seated upon two tubercles placed at the base of the two large tentacles. These mollusks inhabit warm mossy banks and woods. Referring to the figure 2614, *a* represents the Cyclostoma involvulus; *b*, the Cyclostoma elegans with the animal; *c*, the same in such a view as to show the foot. We have abundant specimens of the latter shell taken on the warm chalk hills covered with brushwood near Caversham, close to Reading, Berkshire. It is the Turbo elegans of Lister and others.

2615.—THE PELLUCID VITRINA

(*Helicolimax pellucida*). The genus Vitrina has been divided by M. Férussac into two subgenera, or, as some may regard them, genera, named Helicolimax and Helicarion, of which the latter consists of foreign species. In the former there is no terminal mucous pore, which is present in Helicarion. In other details they agree. The shell is small, delicate, spiral, without an umbilicus; and in general the body of the animal is too large to be entirely retracted within. The tentacles are four, cylindrical, and retractile; the two upper ones ocellated at their summit. These snails inhabit moist places, and are generally to be found on plants under dead leaves, and in the chinks and fissures of rocks.

The Vitrina (Helicolimax) pellucida, or Helix pellucida of Müller, is a common British species, and was erroneously regarded by Montagu as the young of Helix lucida. The figures represent the animal of the natural size, and the shell in two views magnified.

2616.—CUVIER'S HELICARION

(*Helicarion Cuvieri*). In our illustration, *a*, *a* represent the shell of Cuvier's Helicarion in two views; and *b* is an allied species of the Helicarion Freycinetti.

2617.—THE GLOSSY BULINUS

(*Bulinus lubricus*). The genus Bulinus (as the word is written by Adanson), or Bulimus (as most naturalists write it), is distinguished from Helix by the mouth of the shell being oval; while the shell, instead of being more or less orbicular, has the whorls drawn out or turreted; and the reflected lip or border on the right side is generally very thick. The last whorl often exceeds all the rest put together. The geographical distribution is very extensive.

The Bulinus lubricus is a minute shell, common in Europe, transparent, and of a smooth shining horn colour. It is represented at *a* of the natural size, and at *b* magnified.

2618.—THE ROSEATE BULINUS

(*Bulinus rosaceus*). *a*, the adult animal and shell; *b*, a young shell before the mouth is reflected; the mouth is represented as sealed with the parchment-like membrane, which shuts in the animal during hybernation; *c*, one of the eggs broken, discovering a young shell; *d*, an egg unbroken.

The adult shell is roughish; the apex and upper whorls are of a rose colour in fine specimens; the other whorls brownish, mottled longitudinally with dirty white; suture crenulated; lip white; epidermis greenish.

This species is found in South America; Mr. Cuming observed numbers during the dry season adhering to the under side of stones among bushes, close to the edge of the shore, sometimes even within reach of the spray. He also met with them on hills of a thousand feet above the sea, concealed between the lower leaves of an aloe-like plant, on the honey of whose flowers the giant humming-bird (Trochilus Gigas) is accustomed to feed. "The natives burn down clumps of these plants for the sake of the rings at the bottom of the footstalks of the leaves, which they use as buoys for their fishing-nets, and for baking the coarse earthenware which they make on the hills, because this part of the plant when ignited throws out a great heat. Between these leaves the bulimi lie in the dry season in a torpid state. In the spring (viz. September and October) they burrow in the shady places at the roots of this plant, and among the bushes on the sea shore. At this period they lay their eggs in the earth, about two inches below the surface." During their hybernation, so strong is the parchment-like epiphragma, and so tenaciously does it adhere to the stones, that the shell will often break in the endeavour to detach the animal before the membrane will yield. On Chili and the neighbouring coasts this species is very common, and was found there by Captain Philip Parker King, R. N., who published in the 'Zoological Journal' (vol. v. p. 342) the following account of the remarkable power which this snail possesses of existing for months in a dormant state:—"Soon after the return of the expedition (His Majesty's ships Adventure and Beagle, Survey 1826-30), my friend Mr. Broderip, to whose inspection Lieutenant Graves had submitted his collection, observing symptoms of life in some of the shells of this species, took means for reviving the inhabitants from their dormant state, and succeeded. After they had protruded their bodies, they were placed upon some green leaves (cabbage), which they fastened upon and ate greedily. These animals had been in this state for seventeen or eighteen months; and five months subsequently another was found alive in my collection, so that the last has been nearly two years dormant. These shells were sent to Mr. Loddiges's nursery, where they lived for eight months in the palm-house, when they unfortunately died within a few days of each other. Soon after the shells were first deposited at Mr. Loddiges's one got away and escaped detection for several months, until it was at last discovered in a state of hybernation: it was removed to the place where the others were kept, when it died also. The upper surface of the animal when in health is variegated with ruddy spots and streaks on an ash-coloured ground." The only process used for revivifying these animals was placing them on a plate near a moderate fire, and sprinkling them with tepid water. Upon their restoration, they ate a considerable part of the parchment-like seal or operculum. They lived some time with Mr. Broderip before they were sent to Mr. Loddiges. These animals had been packed up in a box and enveloped in cotton from the time of their capture to the period mentioned, when they were unpacked by Mr. Broderip. Mr. Lyell notices this circumstance when treating on the geographical distribution of testacea, in the third volume of his 'Principles of Geology.'

2619.—THE BLOOD-LIPPED BULINUS

(*Bulinus hæmastoma.*) Referring to the figure,—*a* represents the Egg; *b*, the Egg-shell broken, showing the young animal with its shell in situ; *c*, the Shell of a young one just after exclusion from the egg; *d*, the Shell at a more advanced age, but before the lip is reflected; *e*, the adult Shell.

This species is found in the brakes of St. Vincent and of the Antilles generally; it exists also, according to the Rev. Lansdown Guilding, in Equinoctial America also. The young shell is semi-transparent, but becomes opaque as it advances in age. The adult shell is brown, strongly striated or wrinkled longitudinally with a rose-coloured mouth: epidermis brown.

An allied species, the Bulinus ovalis, but of considerably larger size, from Rio, lived for some time in a hot-house in the Horticultural Gardens at Chiswick, and laid three eggs.

It was brought over in October, 1828, by Mr. William M'Culloch, then gardener to the Right Hon. Robert Gordon, and presented by him to the Horticultural Society. At first it appeared rather sickly, but after it had been kept in the hot-house for some time, it recovered and began to move about. Mr. Booth, who was on the spot, says, "It cannot now be correctly ascertained when it produced the first egg, but it was very shortly after its arrival; I should think about the beginning of November. This egg was sent, by the desire of Mr. Sabine, to the Zoological Society. About the same time this year (1829), it produced a second egg, and, three weeks afterwards, a third: the latter was unfortunately broken by the animal itself, but the former is still in preservation. It fed upon lettuces and the tender leaves of cabbages; the former seemed to be its favourite food. Sometimes it would devour two large lettuces, and then remain for days afterwards without touching food or moving from its place, except when cold water was sprinkled upon it. During the day it was usually in a dormant state in the shade; but towards the evening, when the house was moist and warm, it would spread itself out, and move from one part to another. It seemed to like moisture, and I have no doubt that it might have been preserved for years, if it had not been accidentally killed. On Saturday last it was at the end of the house where the fire comes in, and ventured too far upon the hot bricks after they had been watered. In the morning it was found fixed to them and quite dead." ('Zool. Journal,' vol. v. p. 102.)

2620.—THE THREE-BANDED BULIMULUS

(*Bulimulus trifasciatus*). Bulimus Guadaloupensis, Brug. The genus Bulimulus, established by Dr. Leach, differs from Bulinus principally in the delicacy of the outer lip.

The three-banded Bulimulus is a very common species in the West Indies, varying considerably in colour; and it is remarkable that it occurs imbedded in the limestone of the "grande terre" of Guadaloupe, which incloses fossil human skeletons, of which one is in the British Museum. Respecting these skeletons, Mr. Lyell ('Principles of Geology) says, that "several, more or less mutilated, have been found in the West Indies, on the north-west coast of the main land of Guadaloupe, in a kind of rock which is known to be forming daily, and which consists of minute fragments of shells and corals, incrusted with a calcareous cement resembling travertin, by which also the different grains are bound together. The lens shows that some of the fragments of coral composing this stone still retain the same red colour which is seen in the reefs of living coral which surround the island. The shells belong to the neighbouring sea, intermixed with some terrestrial kinds, which now live on the island, and among them is Bulimus Guadaloupensis." There is another human skeleton from the same rock in the Museum at Paris. M. König has published an interesting paper on the skeleton in the British Museum in the 'Philosophical Transactions.'

2621.—THE UNDULATED PLEKOCHEILOS

(*Plecocheilus undulatus*). Shell and Animal. The Rev. Lansdown Guilding, who founded the genus, describes the shell as barely umbilicate, dextral, oval, spiral; the spire elevated but obtuse; the two last whorls the largest, and ventricose; aperture entire and elongated; columella with a single plait; lip thickened.

This elegant species abounds in immense numbers in the forests of St. Vincent, and generally emerges from its retreat on the approach of evening, but is not unfrequently to be seen abroad during the day. The shell is stout, plaited longitudinally, and indistinctly striated transversely. The general colour is ferruginous chestnut, with oblique brown undulated bands. The body of the snail is olivaceous, pallid beneath. In young specimens, as was observed by the Rev. Lansdown Guilding, the shell is without striæ, diaphanous, prettily corroded on the surface, with simple lips. Old shells are covered with a thick brown epidermis. The eggs are agglutinated to the leaves of the Tillandsiæ, which from holding water secure a damp atmosphere at all times.

Fig. 2622 represents the shell of Plecocheilus undulatus in two views: at Fig. 2623, *a* is a Young Shell of the same; *b*, an Egg magnified; *c*, the same the natural size; *d*, Apex of Nucleus of Shell enlarged.

2624.—THE MEGASPIRA

(*Megaspira Ruschenbergiana*). According to Mr. Lea this form is closely allied to Bulinus and Pupa. It is a terrestrial shell, remarkable for the production of its spire, which consists of twenty-three close-set, narrow, gradually increasing whorls; and the outer lip is reflected. The mollusk is unknown: colour of shell brownish, with darker spots.

Family LIMNÆIDÆ (LIMNÆA, PLANORBIS, &c.).

The mollusks of this family are the tenants of fresh waters, either stagnant, or with a gentle current, coming up to the surface for the purpose of respiration. In such brooks as that represented at Fig. 2625, abounding in aquatic plants, and gliding smoothly along, they exist in vast numbers. They have only two tentacles, according to Mr. Garner ('Linn. Trans.' vol. xvii., p. 403). The planorbis respires both air and water.

In this family Cuvier places a shell-less group (onchidium), most of the species of which live at the margin of the sea, alternately covered and left dry by the tide.

2626.—THE HORNY PLANORBIS

(*Planorbis corneus*). In the genus Planorbis, the animal is elongated, compressed, slender, and very strongly rolled up; head furnished with two ten-

tacles, which are contractile, setaceous, very long, and oculated at their internal base; mouth furnished superiorly with a crescent-shaped tooth, and below with a lingual mass armed with small hooks, and surmounted by a sort of veil which is short and notched; foot oval and rather short; respiratory orifice on the left, upon the collar.

Shell rather delicate, sinistral, very much rolled or coiled up on the same plane; concave on each side, the spire re-entrant (rentrant); aperture rounded with a sharp border, and interrupted by the convexity of the whorl which precedes it. (Rang.)

Mr. Sowerby remarks, that the principal peculiarity in this genus appears to him to consist in the fact, that the shells are what are called reversed; a fact doubted by some who have described them as umbilicated above. A careful examination of many of the species, in a living state, satisfied Mr. Sowerby, that these animals carry their shells in a direction opposite to that of the turbinated mollusks generally, and that the heart is placed on the right side, and the respiratory orifice on the left, exactly the reverse of their position in most others; but he farther observes, the knowledge of the animal is not necessary to prove this, as the shell itself carries the demonstration, it being only needful to observe on which side of the shell the very apex of the spire is to be seen; if we take that side for the upper, in conformity with the strict rules of analogy, it will be evident that the aperture is on the left-hand side. We may add that we have now before us a number of shells of Planorbis, in which the mouth turns obliquely to the left, and on that side the apex of the spire is visible; hence is the shell sinistral. This, however, is denied by some naturalists, and especially M. Deshayes, who contends that the shells are dextral, even those which the most esteemed authors had judged to be sinistral from the depth of the umbilicus on the right side. He, indeed, admits that with respect to the position of the heart on the right, and the pulmonary orifice, &c., on the left, as Cuvier has remarked, the animal is sinistrally organized, but he affirms that the other viscera are placed as usual, whence he regards the mollusk as really dextral, like Helix, and he adds "thus the observations of M. Desmoulins explain how in the genus Planorbis, appearances place a sinistral animal in a dextral shell, and how in reality the animal is dextral as well as its shell," there being no derangement of organs, excepting with regard to the heart and the orifices.

The Planorbis corneus (Helix corneus, Linn.) is the largest European species, and is found in sluggish streams, stagnant waters, deep drainage courses, &c. We have found it common about Reading, and it is, we believe, plentiful about Oxford. We have taken it in the neighbourhood of Hammersmith, in deep clear ditches, where the water-newt was plentiful.

Montagu, as well as others, have observed that this species yields a very beautiful purple dye, but all attempts to fix it, by means of acids or astringents, have hitherto proved ineffectual. The shell is opaque, of a horny brown colour, with the whorls transversely striated. In fine specimens, the mouth is tinged with pale violet or lilac.

2627.—The Keeled Planorbis

(*Planorbis carinatus*). This species, which is remarkably flat and thin, has the outer edge finely keeled; the colour of the shell is brown. It is very abundant in fresh water, either running or stagnant; the mollusk is of a slender figure, with long tentacles. Referring to Fig. 2627: *a* represents the Shell and Animal of Planorbis carinatus; *b*, a mass of the Eggs of Planorbis corneus on a leaf.

2628.—The Common Physa

(*Physa fontinalis*). In the genus Physa, the shell is generally sinistral, of an oval or elongated figure, sometimes nearly globular, smooth, delicate, and very fragile. The aperture is oval; the edge of the right lip sharp. The genus is very extensive, species occurring in the fresh waters of the four quarters of the globe.

The Physa fontinalis is found in the fresh waters of England and the adjacent continent, inhabiting sluggish streams and stagnant waters: we have found it not unfrequently on the under side of the leaves of the water-cress, and other plants. The shell is smooth, diaphanous, and of a yellowish horn colour; the spine is short and rather pointed. Col. Montagu, who gives a description of this species, states, that when in motion it covers a great part of the shell with a thin pinnated membrane, thrown out on the right side, extending quite behind and partly on the left side, covering the smaller volutions: this membrane (mantle) is, he says, very deeply divided, or digitated, the points of which meet and sometimes intersect on the back of the shell, and it is so transparent as scarcely to be distinguished but by the assistance of a glass. The foot he describes as long and narrow, and the foramen on the left side, "as must be the case with all the animals of this kind inhabiting heterostrophe shells." Col. Montagu concludes his remarks on this species as follows: "It has a very considerable locomotive power, and transports itself by adhering to the surface of the water, with the shells downwards: against which it crawls with as much apparent ease as on a solid body; and will sometimes let itself down gradually by a thread affixed to the surface of the water, in the manner of the Limax filans ('Linn. Trans.' iv., 85, t. 8), from the branch of a tree. The property of crawling under water, against its surface, is not wholly confined to this species; but we know of no other testaceous animal capable of suspending itself under water in the same way.* It has the power of throwing its shell about in an extraordinary manner, either in defence or to remove obstructions, continuing at the same time fixed by its foot. Probably this singular motion is sometimes occasioned by a minute species of Hirudo (Gordius inquilinus, Müll., Verm.), which infests this and many other fresh-water testaceous animals; twenty or more may be seen adhering to its sides like slender white filaments."

Fig. 2629 exhibits an allied species, Physa Hypnorum: *a*, the Animal and Shell; *b*, the Mass of Eggs, natural size; *c*, the same, magnified.

The eggs of the Physa invested in a gelatinous medium are very common on the leaves or stalks of the water-cress.

2630.—The Common Limnæa

(*Limnæa stagnalis*). In the genus Limnæa, the animal is of an oval form, more or less spiral; head furnished with two flattened triangular tentacles, carrying the eyes at their base, on the internal side; mouth furnished with an upper piece for mastication, surmounted by a sort of very short veil; foot oval, bilobated anteriorly, narrowed posteriorly; orifice of the pulmonary cavity on the right side, on the collar, in form of a furrow, and capable of being covered by a fleshy appendage which borders it below.

Shell delicate, fragile, of an oval oblong, with a spire more or less sharp and elongated, and an aperture longer than it is wide, oval, sometimes very large, with a sharp edge, not continuous, on account of the convexity of the preceding whorl; on the columella an oblique plait.

M. Deshayes observes (last edition of Lamarck) that the animal of Limnæa presents peculiar characters. On the head are two triangular tentacles very much enlarged at the base, and having the eyes rather projecting on the upper and internal part of that base. The head is large and flattened, separated from the foot by a shallow furrow. The foot inclines to oval, terminated in a point posteriorly, and is delicate and flattened on the sides. The mantle closed anteriorly and narrow, forms a sort of collar, as in the Helices. There is a great cavity behind its border. The upper wall of this cavity, delicate and transparent, is covered on its internal surface by a very well developed vascular net-work, destined for respiration.

The limnæa is abundant in still or sluggish fresh waters, where it feeds on aquatic plants, up the stems of which it creeps, coming up to the surface for the purpose of respiration. We have often seen them floating in the reversed position like the Physa; they have, in fact, when so situated the power of locomotion, and may be observed moving their ventral disc, as if crawling along some solid surface, whereas it only acts on the water, of which the surface offers sufficient resistance to the vermiform movements of the disc, to enable the mollusk to work its way. The eggs are very numerous and enveloped in a mass of glairy gelatine of an elongated form; they are deposited on stones, or on the leaves or stems of vegetables. The shell is very delicate, and pellucid; the spire is produced and conical. The external colour is brown, but the shell is often covered with a sort of greenish or greyish green calcareous deposit, varying in thickness, as in many specimens now before us; the cause of this deposit we are unable to explain. The same occurs on Limnæa auricularia. Fig. 2631 represents the Animal and Eggs of Limnæa stagnatilis: *a*, the Animal and Shell; *b*, the mass of Eggs magnified.

2632.—The Spreading Limnæa

(*Limnæa auricularia*). This species, distinguished by the shortness of its spine, the capacity of the last whorl, and the extent of the spreading mouth, is common in the same localities as the last species, which it resembles in habits and manners.

Fossil specimens of Physa, Planorbis, and Limnæa occur in considerable abundance in fresh-water tertiary formations of Europe; but the number of distinct species does not appear to be very clearly made out.

Mr. Lea, in his 'Contributions to Geology' (8vo. Philadelphia, 1833), notices the tufaceous lacustrine formation of Syracuse, Onandaga county, New York. He found the substratum which lined the side of the canal to consist of a calcareous marl of a whitish colour, bordering on that of ashes, friable, and rather soft to the touch. A subsequent analysis by Professor Vanuxem proved it to be nearly pure carbonate of lime. Numerous perfect specimens of the genera Limnæa, Physa, Paludina, and Ancylus were obtained, all being analogous to the species inhabiting at that time the fresh waters of that region; and Mr. Lea states that it was evident that the deposit was caused by the drainage of the lake. The specimens were found to be completely bleached, and were generally in an unbroken state. "A lacustrine formation of so recent a nature," says Mr. Lea in continuation, "as this appears to be, is not, I believe, of frequent occurrence. It is the result, however, of one of those causes which are now in action; and another instance might be mentioned, in which the effect of this cause, though striking, has not advanced to that period when it would make a finished deposit; I mean the small lake, or pond, in Sussex county, New Jersey, well known by the descriptive name of Milk Pond.* Here countless myriads of bleached shells of the families Lymnæana and Peristomiana, analagous to the species now inhabiting the adjacent waters, line and form the shores of the whole circumference of the lake, to the depth and breadth of many fathoms. Not having visited this interesting lake myself, I repeat what has been communicated to me by intelligent scientific friends who have examined it, and on whose report the most implicit reliance may be placed. Such is the quantity of bleached shells now remaining there, that thousands of tons of these small species, in a state of perfect whiteness, could be obtained if any useful purpose required the removal of them. For agricultural purposes this mass might prove of great utility. One friend, I remember, mentioned to me that he had obtained a sharp pointed pole, which he inserted ten or twelve feet perpendicularly into the mass, on the shore, near to the edge of the water, without its having passed through it. As far as can be ascertained, this mass seems to form the whole basin of the lake, and it may at some future and perhaps not far distant period form a tufaceous lacustrine deposit similar to that of Syracuse."

Family AURICULADÆ (AURICULA, MELAMPUS, &c.).

2633.—Midas's Ear

(*Auricula Midæ*). The genus Auricula differs from those of the preceding aquatic air-breathing mollusks in the columella of the shell being marked with decided oblique channels (canelures). The figure of the shell is oval or oblong; the mouth longitudinal, with a reflected lip, or simple. Cuvier says, "we are not certain if these animals live in marshes, as the Limnæa, or only on their borders, as the Succineæ" (Helix putris, Linn.). One species exists in France along the borders of the Mediterranean (A. myosotis). A writer on conchology observes, "The probability is that the auricula lives in the neighbourhood of rivers, lakes, or morasses, and that its respiratory system, though formed for breathing air, is so framed as to enable it to sustain any vicissitudes which such a locality might render likely to occur."

The Auricula Midæ is said to be a native of the East Indies; Lamarck names the Moluccas as also among its localities. It is a handsome shell, and well known to collectors under the name of Midas's ear.

2634.—The Cone-shaped Melampus

(*Melampus coniformis*). As in Auricula, the shells of the genus Melampus have salient folds on their columella, but the external lip of the opening has no roll, and is finely striated. The general contour of the shell is that of a cone, of which the spire forms the base. The genus Melampus of De Montfort is identical with Conovulus of Lamarck.

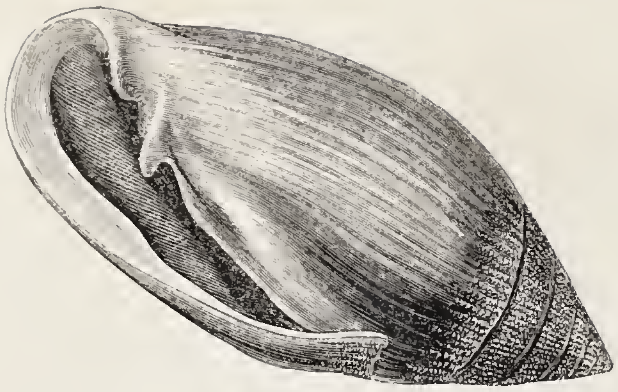
The Cone-shaped Melampus is found in the rivers of the Antilles Islands.

ORDER NUDIBRANCHIATA.

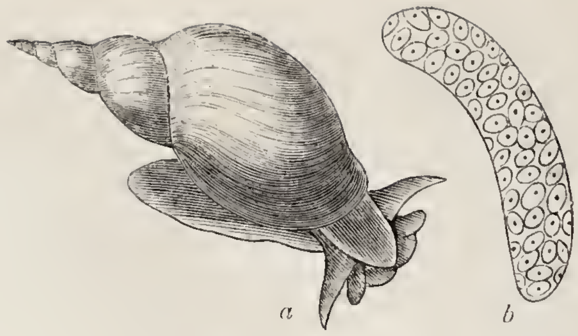
The mollusks of this order are not enclosed in or protected by shells; they have no pulmonary chamber, but the branchiæ or organs of respiration are seated on some part of the upper surface, freely exposed to the water. All are bisexual and marine. Many species have the habit of swimming reversed, with the foot, which is concave like a boat, at the surface of the water, and they further assist them-

* The Ianthina, a marine shell mollusk, is said to have a similar power.

* From the milky appearance of the waters near the shore, caused by the mass of bleached shells deposited there. In Gordon's map of New Jersey it is named White Pond. (Lea.)

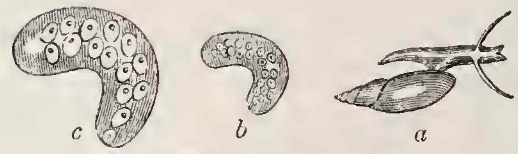


2633.—Midas's Ear.

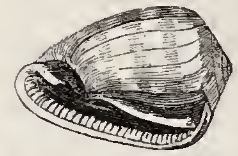


2631.—Limnæa stagnalis, and Eggs.

2625.—Marl Cliff and Brook.



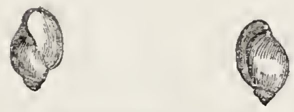
2629.—Physa Hypnorum.



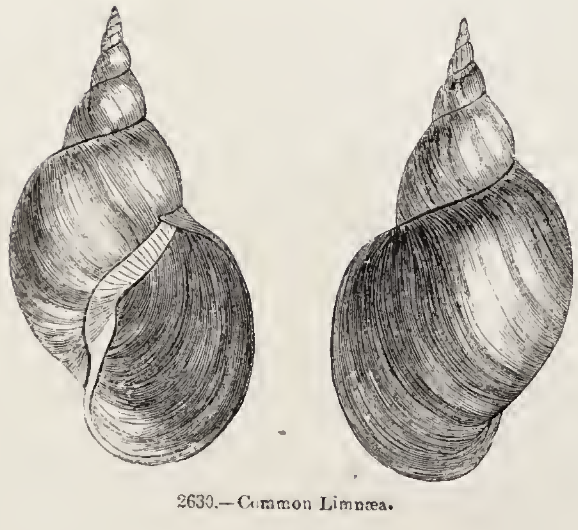
2634.—Cone-shaped Melampus.

2627.—Keeled Planorbis.

2632.—Spreading Limnæa.

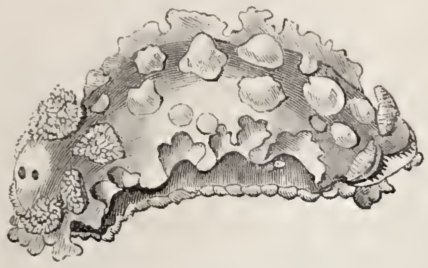


2628.—Common Physa.

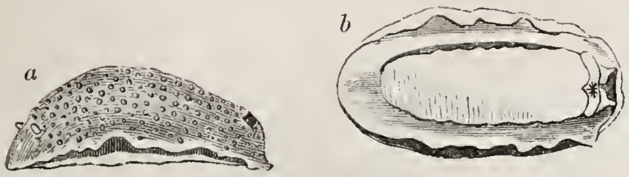


2630.—Common Limnæa.

2626.—Horny Planorbis.



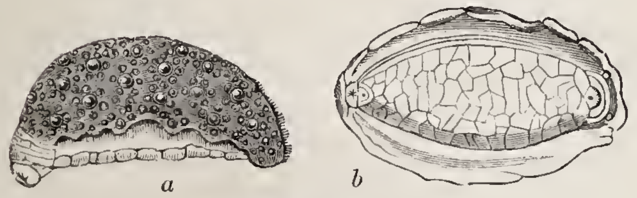
2637.—Jagged Doris.



2638.—Leach's Doris.

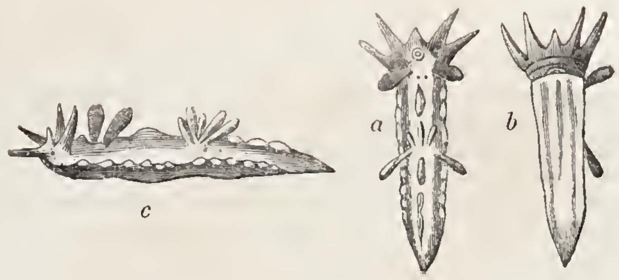
2640.—Pterosoma.

2643.—Cuvier's Eolidia.

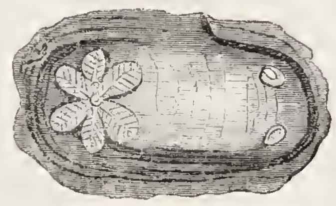


2639.—Peronia.

2644.—Cavolina.

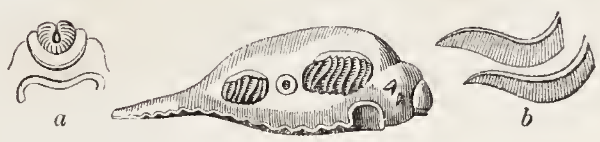


2635.—Horned Doris.

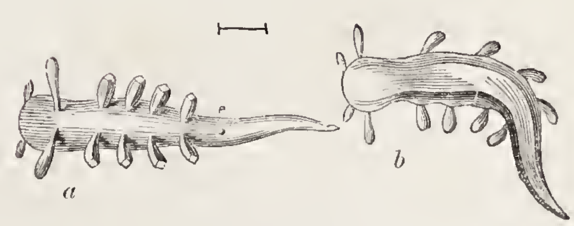


2636.—Flat Doris.

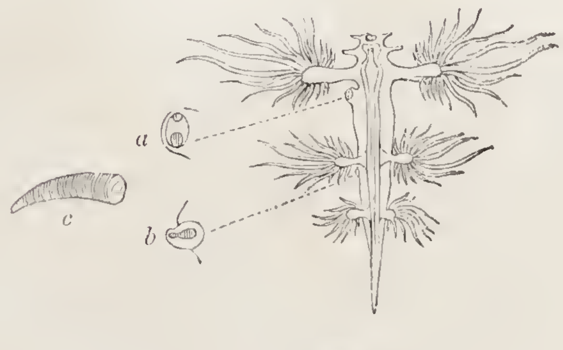
2646.—Tethys.



2641.—Laniogerus.



2645.—Tergipes.



2642.—Glaucus.

selves by means of the edge of their mantle, and by their tentacles, which serve as oars.

As examples of this group we may mention Doris, Polycera, Tethys, Laniogerus, &c. Of the general aspect of these mollusks, commonly called sea-slugs, our pictorial specimens will convey a clear idea.

2635.—THE HORNED DORIS

(*Doris cornuta*). Polycera cornuta, Cuv.

The subgenera upon which the genus Doris, a term originally applied by Linnæus to a single species, is subdivided, are several, depending upon minor peculiarities.

In the present species (Polycera of Cuvier), the branchiæ, in the form of projecting foliated branches, are disposed as usual in a circle, at the posterior part of the body, and followed by two membranous strips which cover them when danger threatens. The anterior edge of the mantle projects in the form of strap-like prolongations symmetrically disposed. Referring to Fig. 2635, *a* represents the animal as seen from above; *b*, as seen from below; *c*, a side view.

2636.—THE FLAT DORIS

(*Doris Solea*). In this form the body is extremely depressed, the anterior border of the mantle is simple, and the branchiæ assume the shape of a foliated star at the posterior part of the body.

2637.—THE JAGGED DORIS

(*Doris lacera*). In this form the body is convex above, with tuberculous eminences, club-like tentacles, and the branchiæ in a circle of tufts at the posterior part of the body.

2638.—LEACH'S DORIS

(*Onchidoris Leachii*). It is only on certain anatomical points that this genus is separated from Doris. The tentacula are four, besides labial appendages; *a*, side view of the mollusk; *b*, underneath view.

2639.—THE PERONIA

(*Peronia Mauritiana*). A slug-like mollusk, with the branchiæ nearly retiform in a cavity situated at the posterior region of the back; and opening externally by a round mesial orifice pierced at the inferior and posterior part of the borders of the mantle. M. Blainville observes that this genus contains the marine onchidia of Cuvier, of which four or five species are known from the southern hemisphere. Cuvier, we may add, regards the onchidia (genus onchidium) as forming part of the pulmoniferous gastropods; but M. de Blainville refers the genus to the same family as that containing the Doris. Cuvier, commenting on this view of De Blainville, says, "I cannot perceive any real difference between the respiratory organ of Onchidium or Peronia, and that of the other pulmoniferous mollusks." *a*, side view of Peronia; *b*, the under surface or foot.

2640.—THE PTEROSOMA

(*Pterosoma*). M. Lesson established the genus Pterosoma on a single species of mollusk which he discovered in great abundance in the equatorial seas between the Moluccas and New Guinea, where it was seen swimming about with great celerity. The animal is gelatinous, transparent, elongated, cylindrical and convex in the middle: the body lies between two lateral swimming membranes, one on each side; these are delicate and horizontal, originating at the tail and continuing in an oval form beyond the head, where they unite in front of the mouth; the anterior border is thicker than the posterior, which is narrowed and thin; the mouth is simple, there are no tentacles, the eyes are sessile, oblong, and approximated to each other. So transparent is the body that the internal viscera may be seen through its substance. The branchiæ do not appear to have been detected, but it is not improbable that the swimming membranes may serve the purpose of those aerating organs.

2641.—THE LANIOGERUS

(*Laniogerus Elfortii*, Blainville). This animal is closely allied to the Glaucus, and the genus was established by M. de Blainville on an individual in the British Museum. M. Rang remarks that its figure recalls the appearance of Glauci preserved in spirits of wine, which having become swollen, as is usually the case after death, have also at the same time lost some of their branchial cirrhi. There are two pairs of tentacles; the head is distinct, the mouth subterminal; on each side of the body are the branchiæ, forming a series of soft laminæ finely pectinated. Referring to Fig. 2641, *a* represents the mouth; *b*, the branchial cirrhi.

2642.—THE GLAUCUS

(*Glaucus hexapterygius*). This brilliant sea-slug, common in the Mediterranean and extensively spread through the wide ocean, is distinguished for the beauty of its colours, azure blue and silvery white being the predominating tints. It swims in a reversed position with great quickness. The general characters are as follow:—Texture gelatinous, form elongated, slightly flattened, and terminating in a point; foot very narrow and almost rudimentary; head distinct, furnished with four very short flattened and triangular tentacles, mouth subterminal; branchiæ disposed in pairs on the sides and fitted for swimming, consisting of oblong processes surrounded by digitated appendages. The species, says Cuvier, are not as yet well distinguished.

M. Deshayes in his edition (1836) of Lamarck remarks that, notwithstanding the researches of several accomplished naturalists, there still exists great uncertainty with respect to many points in the anatomy of this genus. The description of M. de Blainville, he observes, leaves doubts concerning the organs of respiration; nor is it, he adds, certain that the digitations of the fins are branchiæ; indeed he is inclined to believe that they are not; and he quotes the observations of M. Quoy, who affirms that these digitations are very caducous in the living animal, which detaches them when they are touched; and he argues that it is scarcely credible that this would take place were these parts actually destined for so important a function as that of respiration. M. Deshayes therefore insists upon the necessity of new researches upon the organization of these curious animals. He considers, moreover, that one species only is as yet known, of which most of the figures published are very inexact, with the exception of that given by MM. Quoy and Gaimard ('Voy. de l'Astrol. Zool.' T. 2, pt. 26), which, he says, conveys a good idea of this elegant mollusk.

The following account of a species of Glaucus, by Mr. J. C. Lees, was read at one of the scientific meetings of the Zool. Soc., accompanied by a drawing of the animal referred to:—

"Being at sea about two years ago, between the Azores and the Bahama Islands, in about lat. 30° N., long. 50° W., I observed the surface of the sea thickly covered in every direction, as far as I could see, with small animals. Having drawn up some of them in a bucket, I found them to have bodies and tails nearly resembling those of a lizard, but the head was thick and blunt, without any appearance of a neck. I could not discover either eyes or mouth. Four short arms or limbs were attached to the body, nearly in the same situation as the legs of a lizard, and from the outer end of each of them proceeded in a radiating direction fifteen slender feelers, diminishing to a fine point, the centre ones larger than the others. The animals were of a deep but vivid blue colour, with a bright well-defined line of silver down the back from the head to the extremity of the tail; this streak of silver branched off also into the arms and along each of the feelers, till towards the points it formed so thin a line as to become gradually imperceptible. The under part of the animals was of a silvery white; their appearance was very beautiful; they were about one inch and a half long from the front of the head to the end of the tail, and about the same across, from the extremities of the longest of the opposite feelers. The water continued covered with them for two days, during which time we sailed over about one hundred miles; the number of them must, therefore, have been prodigious. They remained perfectly quiet on the water, except when touched, when they either partially or entirely drew themselves up into a ball. They could in this manner draw up either one or more feelers, or the whole limb with its fifteen. They did not appear to notice the approach of a finger or piece of stick until it actually touched them, and then did not attempt to swim away, but only drew up the part touched with a sudden and apparently angry jerk of the head. If the touch was violent or repeated, they drew themselves entirely up in a globular form, and the same thing occurred when they came in contact with each other. I endeavoured to preserve some of them alive by keeping them in sea-water, but in three or four days they all died, and immediately shrunk up into a shapeless mass of a brown colour. I was equally unsuccessful in my endeavour to preserve them in spirits, in strong salt and water, or in vinegar; the instant they were introduced into those liquids they shrivelled up into a brownish shapeless mass." ('Proceeds. Zool. Soc.,' April 23, 1833.)

In the 'Proceeds. Zool. Soc.' for 1836, p. 113 et seq., is the following interesting paper on the Glaucus by Mr. G. Bennett, detailing the results of his personal observations.

"On the 20th of April, 1835, during a voyage from England to Sydney, New South Wales, in latitude 4° 26′ N., and longitude 19° 30′ W., with light airs and calms prevailing at the time, about 3 P.M., a number of damaged and perfect specimens of the Glaucus hexapterygius, Cuvier, were caught in the towing net. On being immediately removed from the net and placed in a glass of sea water, they resumed their vital actions and floated about in the liquid element, exhibiting a brilliancy of colour and peculiarity of form which did not fail to excite the admiration of the beholders.

"The back of the animal, as well as the upper surface of the fins and digitated processes, and the upper portion of the head and tail, was of a vivid purple colour, varying occasionally in its intensity; appearing brighter in colour when the animal was active or excited, and deeper when remaining floating tranquilly upon the surface of the water. The abdomen, and under surface of the fins, are of a beautiful pearly white colour, appearing as if it had been enamelled. The usual length of my specimens, measured from the extremity of the head to the tail, when extended floating upon the surface of the water, was 1¾ inches; sometimes one or two lines more or less. The body of the animal is subcylindrical, terminating in a tail, which gradually becomes more slender towards the extremity, until it finally terminates in a delicate point. The head is short, with very small conical tentacula in pairs; two superior, and two inferior; three (and in G. octopterygius, Cuvier, four) branchial fins on each side, opposite, palmated, and digitated at their extremities; the number of digitations, however, varying; and the centre digitations are the longest; the first branchial fins, those nearest the head, are larger and denser than the others. The mouth is armed with bony jaws; the body is gelatinous, and covered by a thin and extremely sensible membrane.

"These little animals were very delicate and fragile in their structure, and although many, indeed I may say numbers, were caught, yet very few in comparison were found to be in a perfect condition, some being deficient in one, two, or more fins, and others being completely crushed. Not one of the specimens caught on this occasion, or during the voyage, had the silvery line or streak running down the back, from the head to the extremity of the tail; branching off also to the fins and along the centre of each of the digitations. Several Porpitæ were also captured in the net at the same time with these animals, and serve as food for them.

"It caused much regret to see the change death produced in the beauty of these interesting little animals, and all means of preserving them were found to be useless. When placed in spirits, the digits of the branchial fins speedily became retracted, the beautiful purple gradually faded and at last disappeared, and the delicate pearly white of the under surface of the body and fins peeled off and disappeared; thus did this beautiful mollusk become decomposed in less than the space of an hour. Some mollusks quickly lose their colour after death, but retain their form for a long time; but these speedily change after death both in form and colour, and the beauty before so much admired perishes never to be regained.

"When taken in the hand, the under surface of the animal soon becomes denuded of the beautiful pearly white it previously had, and at that time appears like a small transparent bladder, in which a number of air-bubbles are observed, together with the viscera. On the abdomen being laid open, a large quantity of air-bubbles escaped; and perhaps a query may arise how far they assist the animal in floating upon the surface of the water?

"The figure of Glaucus hexapterygius in Cuvier's work 'Sur les Mollusques,' is tolerably well executed, but no engraving can convey to the beholder the inconceivable delicacy and beauty of this mollusk; in the engraving alluded to, there is an inaccuracy, at least as compared with the specimens before me,—in the digitated processes of the fins not being sufficiently united at the base; in the living specimens before me, they were united together at the base, and then branching off became gradually smaller until they terminated in a fine point.

"But few of these animals were caught after the 20th until the 24th of the same month, in latitude 2° 26′ N., longitude 19° 51′ W., when having light airs from S. by E., nearly calm in the morning, a great number were seen floating by the ship, and it was not difficult, by aid of my towing-net, to capture as many as I required, for they swam very superficially upon the water. The whole of those taken proved to be of the same species (G. hexapterygius) as those before caught. I again placed several of the specimens in a glass of sea water; they were full of life, sometimes moving about, not very briskly, however,—and at other times remaining floating upon the surface of the water, merely gently moving the fins. As they floated upon the surface of the water in the glass, the sides of the head, back, tail, fins, &c., exhibited at the time a light silvery blue colour, which was admirably contrasted with the deeper blue of the upper surface, and falling into the elegant pearly or silvery white of the under surface of the animal, displaying an exceedingly rich and elegant appearance.

Often, when at rest, the animal would drop one or more of the fins, but on touching them they would be immediately raised to the former position, and that organ was turned back as if to throw off the offending object, followed at the same time by a general movement of the whole body. On touching the animal upon the back, it seemed to display more sensitiveness in that than in any other part of the body, judging from the effects produced, in comparison with similar experiments on other portions of the body; for instance, the centre of the back was touched lightly and rapidly with a feather: which caused the little creature to sink as if under the pressure of the touch, throwing at the same time the head, tail, and all the fins upwards, followed by a general distortion of the whole body of the animal, as if the gentle touch had been productive of severe pain. I invariably found every part of the upper surface of the body very sensitive when touched, and displayed a general movement of uneasiness throughout the whole of the body of the creature.

"These creatures have a peculiar manner of throwing the head towards the tail, and flouncing the tail towards the head, when they are desirous of removing any object of annoyance. It is at that time these animals seem to recover from their torpidity, and evince the greatest activity in their movements. When much annoyed, they throw the body about with great activity, coiling up the head, tail, fins, &c., in a somewhat rotundiform position; and if the tormenting object is not removed, dash out again in full activity of body, then return to the rotundiform position, and there remain for a short period apparently exhausted by their efforts. But on the cessation of the irritating cause, the animal quietly resumed its original position, perhaps dropping one or two of its wearied fins according as its own sensations of ease or comfort might dictate.

"When nothing irritated this tender mollusk, it would remain tranquilly floating upon the surface of the water with scarcely any movement but that which proceeded from the undulating movements of the digitated extremities of the fins, as well as an occasional slight twisting motion of the same organs.

"I felt much interest in the beautiful display of a circulating fluid on the dorsal surface of these animals, which was afforded me by the assistance of a microscope. Through the semi-transparent membrane of the back, a fluid could be readily perceived close to the surface, evidently flowing in two directions, one taking a course downwards, and the other returning upwards; but I was unable to distinguish two distinct vessels for these separate actions.

"These animals seemed to be very torpid in their movements, although sometimes, when floating upon the water, they would be seen busily engaged in moving their fins about; but those actions were soon suspended, and their fins were suffered to hang lazily down, as if fatigued with the short exertion, which did not move them one inch about the glass of water; and even when the little indolent creatures did take the trouble to move themselves from one side of the glass to the other, it was effected by a tardy motion, stirring themselves first with one fin and then with the other, according as circumstances might require.

"I placed some small specimens of Porpita in the glass of water containing the Glauci, to observe if they would attack them: for some time one of the Glauci was close to a Porpita, and was even annoyed by the tentaculæ of the latter touching its back, yet the Glaucus bore this, although with the usual characters of impatience, yet without attempting to attack it. At last it seized the Porpita between its jaws, and by aid of a powerful lens, an excellent opportunity was afforded me of closely watching the devouring process, which was effected by an apparently sucking motion; and at this time all the digitated processes of the fins were floating about, as at other times when the animal was at rest; but I did not observe, in one single instance, that they were of any use to the animal, either to aid in the capture or to securely hold their prey when in the act of being devoured; for the animal seems to depend merely upon the mouth in capturing its prey, as in this and other instances, which I had opportunities of observing, they seized their prey instantly with the mouth, and held it by that power alone, whilst by a kind of sucking motion the prey was devoured. The digitations may therefore only be regarded as appendages to the fins to aid the animal perhaps in the direction of its movements, as it was observed that they turned and twisted them about during the progressive motion (that is, when this tardy animal is pleased to progress, which appeared to me very rarely to meet with its inclination), as if in some way or other to direct the movements of the animal.

"The Glaucus, after eating the tentacles and nearly the whole of the soft under surface of its prey, left the horny portion, and remained tranquilly reposing upon the surface of the water after its meal, the only motion visible in the animal being the playing of the digits of its fins. The mutilated remains of the Porpita sank to the bottom of the glass.

"Soon after, another Glaucus began a devouring attack upon another Porpita which had been placed in the glass, eating a little of it, and then ceasing after a short meal, occasionally renewing the attack at short intervals. On examining the Porpita, which had been partially devoured by the ravenous Glaucus, I found the disc had been cleared of the tentacles and other soft parts; a small part of the fleshy portion only remaining upon the disc. Only one part of the horny disc exhibited any injury, and that appeared to be the place where the animal was first grasped by the Glaucus.

"When any of these animals came in contact with another in the glass, they did not display any annoyance, nor coil themselves up, nor did they evince any savage propensities one towards the other; and they would often float about, having their digitated processes in contact one with the other, without exhibiting any signs of annoyance; even when placed or pushed one against the other, they did not manifest any irritation, but remained undisturbed as in their usual moments of quiet repose.

"On the back of the animal being seen in a strong light, a black line could be discerned on each margin, and passing down the centre of each fin, and sometimes varied in having two black lines on the upper part of one fin, although the opposite fin may display but one.

"The margin between the falling of the purple colour of the back into the silvery white of the abdomen often exhibited beautiful tints of a golden green; but these variations were probably produced by the effect of different rays of light.

"These animals soon perished; I could not preserve them for any length of time in the glass of sea water, although the water was changed as often as it was thought necessary; the digitated processes of the fins were observed to shrink up on the death of the animal, and the process of decomposition rapidly took place, the whole body becoming a shapeless mass, having a bluish colour of deadly hue for a short period, and then became of a blackish or brownish black colour. I have seldom seen a gelatinous animal which appeared so firm whilst in the water, that proved so speedily to decompose when removed from it; even the beautiful purple of the back, the silvery or enamel of the abdomen, and the silvery blue of the sides, all speedily vanish, indeed instantly disappear, upon the death of the animal, as if it had been washed off; the expansive, delicate, and beautiful fins and digitated processes are no longer seen; they shrank up to nothing.

"Even on taking the animal alive out of the water and placing it upon the hand, that instant almost, from its extreme delicacy, it was destroyed: the digitations of the fins fell off, the least movement destroyed the beauty of the animal: it speedily lost all the deep purple and silvery enamelled tints, and became a loathsome mass. Thus do we too often find animals beautiful in external adornments, curious in their habits and organization, and calculated in every respect to supply us with inexhaustible sources of intellectual gratification, doomed speedily to perish; brief is the period allotted to them in the busy theatre of animated existence; but doubtless, with the gift of existence, they have received from the bounteous hand of their Creator the means of enjoying their fleeting lives.

"To place these little animals in the glass of water from the towing net without injury to their delicate structure required care; so that as soon as they were captured in the net, attached to the meshes, they were not handled, but carefully washed off, which was effected by dipping the meshes in the glass of water, when the animal soon detached itself without sustaining any injury, and floated in the water.

"Although these animals are so fragile, so easily destroyed on being taken out of their natural element, yet they fling themselves about in the water without sustaining any injury, without even the loss of any of the digitated processes of the fins; yet when there is much movement of the water in carrying the glass from one place to another, they are evidently disturbed and restless, and the fins are dropped; if, therefore, a slight motion of the water disturbs them, what can become of these delicate mollusks during tempestuous weather; can they be similar to the delicate ephemeris, doomed to live merely for the space of a day and perish in myriads? From the immense number seen only from the ship—and how many myriads more extended beyond our range of vision—it conveyed to the mind some idea of the profusion of living beings inhabiting the wide expanse of ocean, and a feeling of astonishment at the inconceivable variety of forms and constructions to which animation has been imparted by creative power.

"The tail of this animal has been described as resembling that of a lizard: the comparison is good, not only with regard to form, but also, with perhaps a little more flexibility of motion, when in action. Sometimes the animal throws its tail up to the body, as if intended to brush off any annoying object, and at other times it has been observed to turn the head towards the side as if for a similar purpose. It seems, in the action of eating, to resemble a caterpillar.

"No more of these animals were seen until the 15th of May at 10 P.M., when in lat. 24° 18′·5, long. 31° 0′·01 W., moderate breezes and fine weather; a number of Glauci were captured as well as Porpitæ; some of the latter had been partially devoured, and in some only the horny disc remained; this there was no doubt, from the previous knowledge of the carnivorous propensities of the Glaucus, was their work, more especially as we had positive proof that tribes of them were wandering or prowling about the ocean to-night. This was the last time during the voyage the Glauci were captured.

"From these animals devouring the Porpitæ, we had positive evidence of their carnivorous habits, independent of the structure of the jaws; and the tentacula of the Porpitæ were no protection against their enemies; indeed these appendages were first devoured and the horny disc was alone left, in many instances being quite picked clean; from this circumstance we may infer that the horny disc of the Porpitæ and Velellæ, which previously, and for the last four days, were found in the net, were the remains of those which had been devoured by the Glauci or similar carnivorous mollusks, among which we may with safety include (from the structure of its jaws, and from often capturing it attached to Velella) the inhabitant of the Janthina fragilis or violet shell.

"The more we pursue the investigation of the actions of living objects, the more we see of the unbounded resources of creative power; and, after all our reasoning, must conclude that some wise purpose, though dimly perceptible to our imperfect understandings, is no doubt answered by this great law of organic formation,—the law of variety."

Referring to Fig. 2642, *a* and *b* are two tubercular orifices; *c*, one of the digitations magnified.

2643.—CUVIER'S EOLIDIA

(*Eolidia Cuvieri*). Cuvier describes the Eolidiæ as having the form of little slugs, with four tentacles above, and two at the sides of the mouth. Their branchiæ are laminæ or foliations disposed like scales in more or less close array, down each side of the back. They are widely spread through the ocean. According to M. Rang, 'they do not swim, but suspend themselves at the surface of the water with the foot uppermost, and move well by means of sudden undulations.

Cuvier's Eolidia, the figure of which is magnified, is found in the European seas.

2644.—THE CAVOLINA

(*Cavolina peregrina*). The Cavolina has the tentacles as in Eolidia, and the branchiæ in the form of filaments placed in transverse rows on the back. The Cavolina peregrina is found in the Mediterranean, but other species exist, some of which are very small, as that brought home by MM. Quoy and Gaimard ('Voy. of the Uranie').

2645.—THE TERGIPES

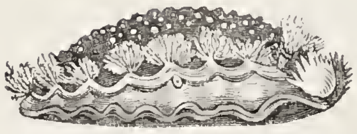
(*Tergipes lacinulata*). With the general form of Eolidia, there are in Tergipes only two tentacles; and along each side of the back is a row of branchiæ of a club-like form, each terminating, according to Cuvier, in a little sucker, and serving as feet, by means of which the animal can crawl in a reversed position. M. Rang doubts the existence of these sucking discs. The figures are magnified: *a*, seen from above; *b*, from below.

2646.—THE TETHYS

(*Tethys leporina*). In the genus Tethys the branchiæ consist of two dorsal rows of branched tufts unequal alternately from right to left, and from front to rear: the head is distinct, and furnished with a large membranous distinct veil, fringed along the edge, forming a sort of funnel, and leading to the mouth, which terminates a short proboscis. The tentacles are two in number, situated at the base of the veil.

The Tethys leporina, which appears to be identical with the Tethys Fimbria, is a native of the Mediterranean, living far from the shore, on banks of madrepore, or among floating masses of sea-weed. It uses the veil or membranous expansion of the head as a swimming organ. Its colour is grey spotted with white. Referring to Fig. 2646; *a* ex-

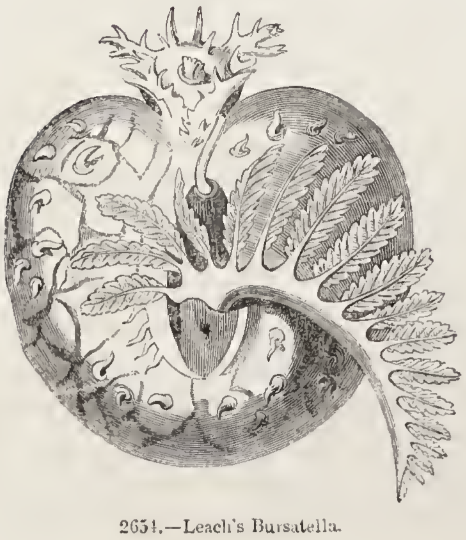
2647.—Roseate Melibe.



2648.—Homberg's Tritonia.

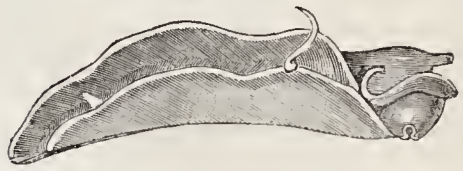
649.—Ocellated Placobranchus.

2650.—Pustular Phyllidia.



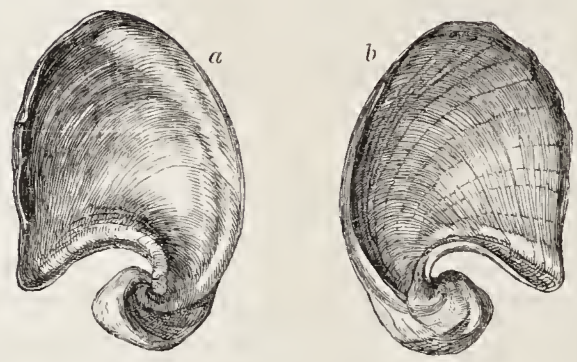
2654.—Leach's Bursatella.

2652.—Depilatory Aplysia.



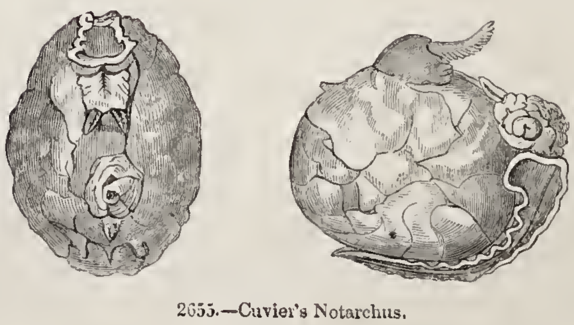
2651.—Brugmans's Diphyllidia.

2647*.—Pelagic Scyllæa.

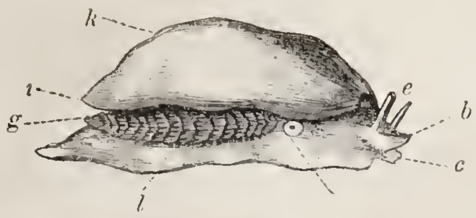


2653.—Dolabella.

2656.—Porous Berthella.

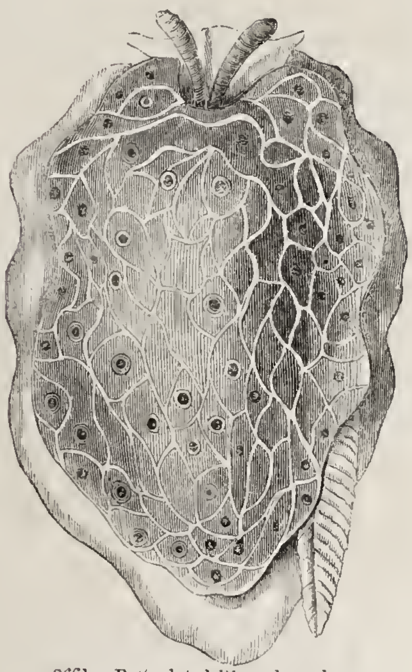


2655.—Cuvier's Notarchus.



2660.—Pleurobranchus

2569.—Meckel's Pleurobranchæa.

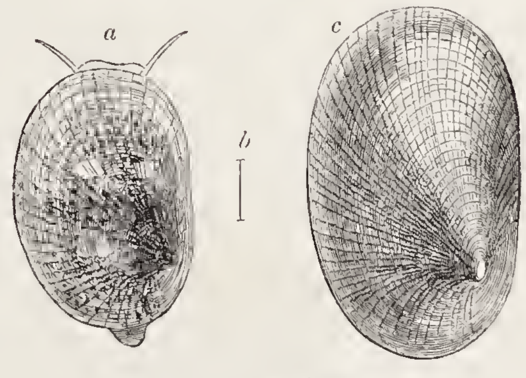


2661.—Reticulated Pleurobranchus.

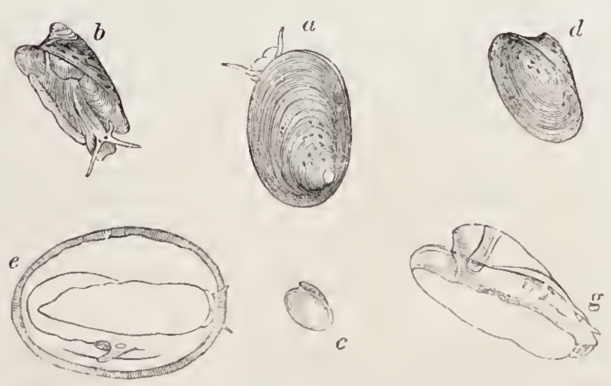
2663.—Mediterranean Umbrella.

2662.—Membranous Pleurobranchus.

2664.—Indian Umbrella.



2658.—Radiated Ancylus.



2657.—Freckled Ancylus.

hibits the animal seen from above; *b*, seen from below.

2647.—THE ROSEATE MELIBE

(*Melibe rosea*). In this sea-slug, which approximates to Tethys, the body is somewhat limaciform, gelatinous, and transparent; the head is furnished with a funnel-like veil, beset interiorly with cirrhi, directed outwardly, and leading to a mouth terminating a small proboscis. Two long slender tentacles rise from the base of the veil, each terminated by a small capsule, from the centre of which rises a short retractile filament. Foot as long as the animal, but narrow, and in the form of a furrow. Branchiæ consisting of two series of club-like processes, which are rounded at their summit, pediculated at their base, and covered with small tubercles. This animal was observed by M. Rang living upon various floating plants in the seas near the Cape of Good Hope. It swims well by agitating the posterior parts of the body from side to side. A slight touch is sufficient to cause disengagement of the branchiæ, as in the Glaucus. Referring to the figure; *b* is the veil around the mouth; *e*, the tentacles; *g*, the branchial club-shaped processes; *h* and *i*, arious orifices; *l*, the foot; *s*, the caudal extremity.

2647*.—THE PELAGIC SCYLLÆA

(*Scyllæa pelagica*). In this genus the head is not very distinct, and of a horse-shoe shape; and there are two large tentacles somewhat club-shaped, but flattened, and split anteriorly, and open at the summit, for giving passage to a small retractile pointed body. The mouth terminates a minute proboscis, and is furnished with an apparatus for mastication. The foot is long, narrow, and furrow-like; the branchiæ are in the form of small tufted pencils scattered over the inner surface of several appendages of skin, rising from the middle ridge of the back. The Scyllæa is extensively spread through the warmer seas, and is to be found among the fronds of the Fucus natans, to which its channelled foot, acting as an efficient grasper, enables it to cling with ease.

2648.—HOMBERG'S TRITONIA

(*Tritonia Hombergii*). This genus approaches Scyllæa. The head is surrounded by two retractile tentacles; the frontal veil is but little developed, and the branchiæ are in the form of branching tufts ranged down each side of the back: the mouth is furnished with two lateral horny jaws like shears, trenchant and denticulated at the edges. Foot long and furrowed. These animals attach themselves to floating sea-weed. Several species exist along the coasts of France, among which is the Tritonia Hombergii; it is of a copper colour.

2649.—THE OCELLATED PLACOBRANCHUS

(*Placobranchus ocellatus*). The Placobranchus is oblong in figure, with a mantle on each side, in the form of two membranous semicircular fins, extending from the neck to the end of the body, capable of being elevated and folded on each other over the back so as to form a sort of tube or canal through which the water circulates, laving the branchiæ. The branchiæ, resembling delicate close-set longitudinal lamellæ, cover the back and lobes. Head depressed with two small approximated eyes, and two pairs of short conical tentacles. The sea-slug on which M. Rang founded this genus was discovered by Van Hasselt on the coast of Java. Referring to Fig. 2649; *c* shows the upper tentacles; *d*, the lower; *b*, the lobes of the mantle; *f*, the branchiæ.

The sea-slugs are oviparous. Mr. Darwin thus writes respecting the Doris:—"While at the Falklands during the autumn of the southern hemisphere, most of the lower marine animals were breeding. I was surprised while counting the eggs of a large white Doris (this sea-slug was three and a half inches long) to find how extraordinarily numerous they were. From two to five eggs (each three-thousandths of an inch in diameter) were contained in a spherical little case; these were arranged two deep, in transverse rows forming a ribbon. The ribbon adhered by its edge to the rock in an oval spire; one which I found measured nearly twenty inches in length, and half in breadth. By counting how many balls were contained in a length of an inch in the row, and how many rows in an equal length of the ribbon, on the most moderate computation, there were six hundred thousand eggs. Yet this Doris was not very common: although I was often searching under the stones, I only saw seven individuals."

ORDER INFEROBRANCHIATA.

THE Inferobranchiata have very nearly the same organization as the animals of the previous order; but their branchiæ, instead of being seated on the back, are in the form of two long series of foliations down each side of the body underneath the extended edge of the mantle.

2650.—THE PUSTULAR PHYLLIDIA

(*Phyllidia pustulosa*). This singular sea-slug, with various allied species, is found in the Indian seas. The mouth is tubular, and there are four small retractile tentacles.

2651.—BRUGMANS'S DIPHYLLIDIA

(*Diphyllidia Brugmansii*, Cuv.) Linguella Elfortii, De Blainville. The genus Diphyllidia of Cuvier or Linguella of De Blainville, differs little from the preceding, excepting that the mantle is more pointed behind. The exact locality of the present species is not ascertained, but an allied sea-slug has been found by M. Otto off the coast of Naples.

The above are the only two forms of the Inferobranchiata given by Cuvier in his 'Règne Animal,' and of these little is known. It cannot, however, be doubted but that other genera will be added from time to time; yet after all there is little in the history of these animals to interest the general reader, though their anatomy may be important to the physiologist.

ORDER TECTIBRANCHIATA.

IN this order the branchiæ, in the form of leaflets more or less divided, are attached along the right side, or seated on the back. The mantle covers them more or less, and contains almost always in its substance a small shell. In some the shell is more fully developed, as in Ancylus, Bulla, &c.

2652.—THE DEPILATORY APLYSIA

(*Aplysia depilans*). In this genus the body presents a single soft fleshy mass; there are four distinct flattened tentacular appendages: the mouth is in the form of a vertical fissure, with two lateral and somewhat horny labial plates, and a cordiform tongue beset with denticles; eyes sessile between the two pair of tentacles; branchiæ covered by a sort of operculum; shell wanting or incomplete; from the borders of the mantle is poured out abundantly a deep purple liquor, with which the animal colours the water around to a considerable distance, when it perceives any danger. Many species are known; they feed on seaweed. The Aplysia depilans, with two or three besides, is found in the European seas; it has been long known in the records of superstition as the Sea-Hare, and was invested with noxious properties; it is indeed extremely fetid, and exudes an acrid humour, which was supposed to occasion the loss of the hair. This sea-slug is often captured by fishermen in their nets, when it suddenly stains the water around it, to their astonishment. The digestive apparatus consists of an enormous crop, leading to a muscular gizzard, furnished with pyramidal cartilaginous teeth; and a third stomach beset with pointed hooks, so as to form a carding machine for tearing the food in pieces, besides a fourth saeculus.

The Aplysia depilans is blackish, more or less blotched with grey or brown, tinged with purple. It adheres to rocks.

2653.—THE DOLABELLA

(*Dolabella Rumphii*). The inside of the shell is represented at *a*, the outside at *b*.

The genus Dolabella, according to Cuvier, differs from Aplysia principally in the position of the branchiæ, which are placed at the posterior part of the body. The dorsal plate is a hard calcareous shell. The Dolabella Rumphii is a native of the Indian seas: other species are found in the Mediterranean.

2654.—THE BURSATELLA

(*Bursatella Leachii*). This large and singular species, which appears to be closely allied to Aplysia, is a native of the Indian seas. The body is subglobular, with an oval disc or foot below, and with a symmetrial oval opening above, formed by the natatory appendages of the mantle, and communicating with a cavity in which is a large free foliaceous gill. There are four branched tentacles, and two labial appendages.

2655.—CUVIER'S NOTARCHUS

(*Notarchus Cuvieri*). The Notarchus is a sea-slug allied to the former, having the lateral crests united and covering the back, excepting a longitudinal fissure which conducts to the branchiæ. The foot is elongated. Shell wanting.

2656.—THE POROUS BERTHELLA

(*Berthella porosa*). This marine slug, which was first described by M. de Blainville (from a specimen sent to him by Dr. Leach), as the type of a distinct genus, is noticed by Donovan as a species of Bulla (Bulla plumula). The body is oval, convex above, with a delicate shell in the mantle; the foot is oval; two tentacles are seated on the head, at the root of which are placed the eyes. There is a single pectiniform branchia on the right side, attached anteriorly, but in a great measure free behind. The animal does not appear to be common. Referring to Fig. 2656, *a* represents a side view of this sea-slug; *b*, a view of the back, to show the internal shell.

2657.—THE FRECKLED ANCYLUS

(*Ancylus irroratus*). The ancyli are little fresh-water slugs, covered with a shell much like that of a limpet, but more compressed, and with the apex placed more backward; like the marine limpets, with which they have been associated by some naturalists, they are found adhering to stones and leaves in fresh-water springs, and streams, and creep with a slow motion. We have specimens now before us, of a British species, which we found under stones, in a clear stream near Reading.

In this mollusk, the head is distinct, the mouth large, the tentacles two and retractile, with the eyes at their base; the branchiæ are in a sort of cavity in the middle of the left side, between the foot and mantle, the animal being, as Rang considers, sinistrorsal.

The Ancylus irroratus is found in abundance on the island of St. Vincent, inhabiting the fresh-water streams and ditches. The shell is concentrically plaited, and covered by a dark green epidermis sprinkled with black: the mollusk is pale yellowish, obscurely sprinkled with black; the foot spotless and pallid. Length of shell three lines.

Referring to Fig. 2657, *a* represents the animal creeping magnified; *b*, the animal reversed; *c* and *d*, the shell; *e*, the figure of the foot, with *f*, the branchiæ in situ; *g*, the animal with the shell removed.

2658.—THE RADIATED ANCYLUS

(*Ancylus radiatus*). The Radiated Ancylus is found with the preceding species. The shell is glassy, diaphanous, with slight concentric plaits, and striated radially. The mollusk is yellowish, sprinkled with black, and with three or four pale marks on the back.

Referring to Fig. 2658, *a* represents the animal creeping, magnified; *b*, the natural length of the shell; *c*, the shell magnified.

2659.—MECKEL'S PLEUROBRANCHÆA

(*Pleurobranchæa Meckeli*). Pleurobranchidium Meckeli, Blainv. This species, the type of the genus Pleurobranchæa, is a slug-like animal found in the Mediterranean. The head is large, with the mouth prolonged in the form of a proboscis; there are two pairs of tentacles, separated considerably from each other. The foot is very large; the mantle, almost obliterated, shows itself along the right side only in a narrow expansion of skin, below which is a pectiniform branchial foliation. There is no trace of a shell.

2660.—THE PLEUROBRANCHUS

(*Pleurobranchus*). In this genus the general form is slug-like, convex above, with a large spreading mantle, often with a thin calcareous shell developed in its substance. The foot is large and outspreading; the head distinct, with a membranous veil, and two tubular tentacles. The mouth is at the extremity of a proboscis, and the branchiæ, composed of a double row of lamellæ, form a plume along the posterior part of the right side.

Referring to Fig. 2660, *b* is the veil; *c*, the mouth at the extremity of the proboscis; *e*, the tentacles; *g*, the branchial lamellæ; *h* and *i*, two apertures; *k*, the mantle; *l*, the foot.

Many species, some of large size and beautiful tints, are found in the Mediterranean and the open ocean. They have been taken at depths varying from the surface to thirty fathoms on rocky coasts, stony beds, and masses of sea-weed. Fig. 2661 represents the Pleurobranchus reticulatus seen from above, showing the reticulations of the mantle, and the branchial lamellæ beneath the posterior edge of the mantle on the right side. Fig. 2662 represents *a*, the shell of the Pleurobranchus membranaceus, external view; *b*, the same, internal view. It reminds us of the shell of Ancylus.

2663.—THE MEDITERRANEAN UMBRELLA

(*Umbrella Mediterranea*). The genus Umbrella is closely allied to Pleurobranchus. The slug is oblong, much depressed, convex above, very fleshy below; the head is not distinct; the mouth is situated in a deep narrow notch in front of the foot, which has thick edges and is raised all round, and is large and spreading, with a smooth and flat undersurface; there are four tentacles; the branchiæ are foliaceous, disposed along the right side; the mantle supports an external calcareous shell, irregularly circular, slightly convex above, concentrically striated, with a conical apex, reminding

us of a circular shield, with a short-spiked central boss.

Referring to Fig. 2663, *a* represents the shell; *b*, the branchiæ; *c*, the head viewed from above. This species inhabits the Mediterranean, and is found in rocky places along the shore.

Fig. 2664 represents the shell of an Indian species, the Umbrella Indica: *a*, the inside; *b*, the outer surface.

2665.—THE SIPHONARIA

(*Siphonaria Sipho*). This form is thus characterized by M. de Blainville:—The animal is oval and subdepressed, with the head subdivided into two unequal lobes, without tentacles or apparent eyes; borders of the mantle crenulated; a branchia in the form of a square membrane, in a sinus formed on the right side between the foot and the mantle; the shell is like that of a limpet, elliptical, with the apex well marked, drawn slightly to the left, posteriorly; a sort of canal or gutter appears on the right side; the internal muscular impression is of a horse-shoe shape.

Though M. de Blainville did not detect eyes, it would appear from the investigations of MM. Quoy and Gaimard ('Zoology of the Astrolabe') that these organs exist, and two very distinct nerves have been detected running from the œsophageal ganglion to them. The eyes in fact are sessile, and in a specimen preserved in spirit of wine might easily become undistinguishable. The animal is described as exuding a viscous whitish humour at pleasure.

Some naturalists have referred this form to the limpets; but, as the organization of the mollusk proves, it belongs to the present order.

The species of Siphonaria are numerous; they are found along the shores of Brazil, the West Indies, Tristan d'Acunha, &c.

Referring to Fig. 2665, *a* exhibits the inside of the shell of Siphonaria Sipho; *b*, the outside.

Fig. 2666 represents a small species of Siphonaria: A, a lateral, B, a ventral view: *a*, the breathing aperture; *b*, the head; *c*, the mantle.

According to M. Deshayes, the number of living species of Siphonaria is twenty-one, of fossil species (in tertiary beds) three.

From these mollusks we pass to a distinct form or family, viz., the Bulladæ, containing the genera Lobaria (Acera or Akera of Müller), Bullæa, Bulla, Sormetus, and Gasteroptera, &c.

The Bulladæ are tectibranchiate; the tentacles are short and broad, and so modified as to form together a sort of fleshy veil beneath which are the eyes; the stomach is complicated, and in many the gizzard is furnished with a calcareous grinding apparatus; several species exude a purple liquor. The shell, in such species as possess it, is more or less rolled upon itself, destitute of a salient spire, with a wide or patulous mouth. A better idea of the form and characters of the animals of this group than mere words can convey will be conceived by referring to our pictorial specimens.

2667.—THE FLESHY LOBARIA

(*Lobaria carnosa*). Acera carnosa, Lam.; Bulla carnosa, Cuv.; Doridium, Meckel.

In this animal the body is oblong, subglobular, and appears as if divided into four parts, viz., one anterior for the head and thorax, one on each side for the swimming appendages, and one posterior for the viscera. There is not a trace of a shell, nor is the stomach furnished with any calcareous apparatus. The branchiæ are covered by the mantle at the posterior portion of the body. The Fleshy Lobaria is the only species of the genus known. It is found in the Mediterranean.

2668.—THE PATULOUS BULLÆA

(*Bullæa aperta*). L'Amande de mer of the French. In the genus Bullæa the shell is delicate, open, and can scarcely be regarded as more than the rudiment of the rolled-up form, which, in Bulla, is carried to greater perfection. It is hidden in the substance of the mantle, and consequently does not contain the animal, the body of which is, indeed, far too large to be covered by so small a shield. The stomach or gizzard is furnished with three very thick rhomboidal pieces of a calcareous structure, worked by powerful muscles. The animals are found at considerable depths, in the sea, on sandy bottoms, where they creep about in quest of prey, with great facility. M. Blainville distinguishes under the name of Bullæa those species which, whether the shell be internal or external, have the foot thick, and not dilated into swimming appendages, and which, consequently, differ in their habits from the Bullæ; the former creeping well, the latter creeping with difficulty, but swimming with facility. He divides the Bullææ, first, into such species as have an internal shell very incompletely rolled up, without spire or columella, of which Bullæa aperta is an example: secondly, into such as have an internal shell, very incompletely rolled up, but with a columella and alveolar spire; of this section he gives Bulla ampulla as an example: thirdly, into such as have the shell internal, and the lateral lobes more developed and cirrhous; he cites Férussac's Bullæa, figured in the 'Atlas Zoologique' of the Voyage of the Uranie, as an example. It will here be perceived that M. de Blainville considerably modifies the characters of Bullæa as established by Lamarck. In the "additions and corrections" to his 'Malacologie,' he carries these modifications to a still greater extent.

Referring to Bullæa aperta, Fig. 2668; A represents the back view of the mollusk; B, the right side; C, the same, with the fleshy plate separated from the dorsal to show the parts between; D, view of the under side; *a*, the fleshy plate that covers the anterior parts of the body; *b*, the fleshy plate that acts as a foot or creeping disc; *c*, the part which contains the imbedded shell; *d*, a portion of the branchiæ; *e* and *f*, orifices. E, the shell removed, and in its natural position; F, the shell viewed on its under or concave side.

The Bullæa aperta is very extensively spread, and has been found at a depth ranging from near the surface to twelve fathoms. Mr. W. Clark (see 'Zoological Journal,' vol. iii. p. 337) states that he found two British species of Bullæa, viz., B. catena and B. punctata, at Exmouth and Torquay, in deep pools at the time of the lowest spring tides, and he obtained a third species, Bullæa pruinosa, by dredging off Budleigh Salterton; the depth at which he dredged is not mentioned, but it must have been considerable, for he observes that the species is rare, and only to be procured occasionally by deep dredging seven or eight miles from the shore. It may be here observed that the Bullæa catena was found to have the gizzard furnished with a calcareous apparatus, but in the two others the gizzards were destitute of this crushing organ. We have now before us the calcareous pieces with which the gizzard of Bullæa aperta is provided; and a most efficient apparatus they form for grinding or crushing the shells of the smaller mollusks on which the animal feeds. It would appear, indeed, to be very voracious; Mr. Sowerby, when speaking of the use of these calcareous pieces, and of their powerful adductor muscles, states that the animal of Bullæa aperta is sometimes absolutely distorted, from having swallowed entire a Corbula nucleus, a bivalve mollusk, with a very thick strong shell, nearly equal in size to itself.

2669.—FERUSSAC'S BULLÆA

(*Bullæa Ferussacii*). In the additions to his 'Malacologie,' M. de Blainville proposes for this species the generic name of Bullina. It is figured in the 'Atlas Zoologique' of the Uranie (Quoy and Gaimard).

2670.—ADANSON'S SORMETUS

(*Sormetus Adansonii*). "Adanson's Sormetus," says Cuvier, "is a species closely related to Bullæa, but upon so imperfect a document (as that given by Adanson, Senegal, pl. 1, vol. i.) I have no grounds for establishing either a genus or even a species." M. de Blainville appears equally at a loss respecting it; and though he provisionally places it near Lobaria, he adds that the animal is utterly unknown.

2671.—THE FRAGILE BULLA

(*Bulla fragilis*). In the genus Bulla, as constituted by Lamarck, the shell is external, covered with a very thin epidermis, and is large enough to serve the mollusk as a retreat. It must be observed that this genus is now greatly restricted, and justly so, from the Bulla of Linnæus, who associated in it the most diverse forms, mollusks formed for breathing air, and others for aquatic respiration; in fact, a heterogeneous assemblage, as Physa, Achatina, Ovula, Terebella, and others, besides those to which the generic title of Bulla is now exclusively applied. The labour of separating these ill-assorted forms was commenced by Bruguières, and carried out by Lamarck.

The Bulla fragilis is stated by Lamarck to inhabit the English channel, near Nantes and Noirmoutiers. It is remarkable for the delicacy and brittleness of its thin shell, which is ovate-oblong, of a horn colour, with fine transverse striæ. The apex rises in the rudiment of a projecting spire. Referring to Fig. 2671 A represents the shell, with the aperture in view; C, a view of the spiral apex, showing the way in which the shell is rolled up; B, the animal.

An allied species, with a much thicker and firmer shell, the Bulla lignaria, is also found in the European seas, and occurs on the British coast. It is of a pale wood-brown colour externally, with white striæ running in the direction of the roll of the shell; it is 'L'Oublée' of the French.

2672.—THE BELTED BULLA

(*Bulla Velum*, Gmel.) Bulla fasciata, Bruguières.

This species is said to be a native of the Indian seas; the shell is extremely delicate, and of a light horn colour, with a snow-white band about the middle, bordered on each side with a band of dark brown; the apex and base are white, also bordered with dark brown.

2673.—THE GLOBOSE BULLA

(*Bulla Ampulla*). La Muscade of the French. In this species the shell is strong in texture, solid and somewhat oval, and subglobose in form. Instead of a spine there is a depression or alveolus. The colour is very beautiful, consisting of a marbled mixture of white, plum colour, and reddish. According to Lamarck it is found both in the Indian and American seas, but Deshayes give the European and Indian seas as its abode. The figures are reversed from an oversight in the drawing.

2674.—MECKEL'S GASTEROPTERA

(*Gasteropteron Meckeli*). This little winged mollusk is distinguished from other Bulladæ, by the development of the borders of the foot into broad wings which are used for the purpose of swimming, when it propels itself along, with the back downwards. The gizzard is destitute of calcareous pieces. The lateral gill is uncovered, and there is no shell. This animal is found in the Mediterranean; it is about an inch long, and two inches in length when the wings are expanded. Various fossil Bulladæ have been enumerated by conchologists, and the following notice of it occurs in the 'Penny Cyclopædia.'

"Lamarck enumerates four fossil species, all of them from Grignon: G. Sowerby says that such are only to be distinguished in the tertiary beds and in the green sand. Deshayes in his tables,* speaking of tertiary fossils only, gives two fossil species of Bullæa, one from the sub-Apennine beds, and one from Paris. Of Bulla he enumerates twenty-three fossil in the tertiary beds; and of these, two are both living and fossil, viz. Bulla lignaria and B. ampulla. The first he places in Sicily, in the sub-Apennine beds (Italy), and the English crag at Bordeaux, Dax, in the Touraine, at Turin, Angers, Paris, and Valognes: in short, in the beds of the Pliocene, Miocene, and Eocene periods of Lyell. The second Deshayes quotes as occurring in beds of the Pliocene period only, viz. those of Sicily and the sub-Apennine beds (Italy). In his edition of Lamarck (vol. vii. 1836), he takes no notice of B. ampulla as a fossil, but notices B. striata (which he observes has been confounded with B. ampulla) as a fossil species. He also remarks on the confusion between B. solida and B. cylindrica, and proposes that B. solida should take the name of B. cylindrica; but the Bulla cylindrica of Bruguières, living in the Mediterranean and European seas, should be called B. cylindracea (Pennant's name); and that the fossil Bulla from the environs of Paris, confounded with the latter, should be named Bulla Bruguierei."†

In the Magazine of 'Natural History,' September 1839, p. 460, Mr. S. V. Wood describes the following species of Bulla as occurring in the crag formation, viz. Bulla quadrada, Wood; Bulla catenata, Wood; Bulla dilatata, Wood; Bulla lignaria, Auct.; Bulla ventrosa, Wood; Bulla conulus, Desh.; Bulla concinna, Wood; Bulla cylindracea, Bulla subtruncata, Wood; Bulla obtusa, and Bulla olivula, Wood.

In the same magazine for February, 1839, p. 61, Mr. Bean, in his catalogue of the fossils found in the Cornbrash Limestone of Scarborough, describes a new species of Bulla (B. undulata) with the following remark:—"Mr. G. B. Sowerby, in his genera of recent and fossil shells, says—Fossil species (of Bulla) are only to be distinguished in the tertiary beds and the green sand. For once we must differ from him, at the same time acknowledging the correctness of his general assertions. Fossil Bullæ are certainly rare;—the specimen figured (viz. B. undulata) being the only one that has occurred in this neighbourhood. The Bulla elongata, figured by Professor Phillips in his 'Illustrations of the Geology of Yorkshire,' cannot belong to this genus, as our specimens, though imperfect, have one fold on the pillar."

Here, then, we close our sketch of the fourth order of Gastropodous Mollusks, according to the arrangement of Cuvier. With respect to the manners and habits of the species, our information is necessarily limited. Living at the bottom of the sea, whence they are dredged up by accident, we can seldom observe them in their native element, unless, indeed, while floating on the tranquil surface of the ocean; and then, so different is their appearance from that presented by specimens preserved in spirits of wine, that we can scarcely recognise the species. Hence it is that drawings from preserved specimens are really of little importance, however valuable to the comparative anatomist these specimens may be;

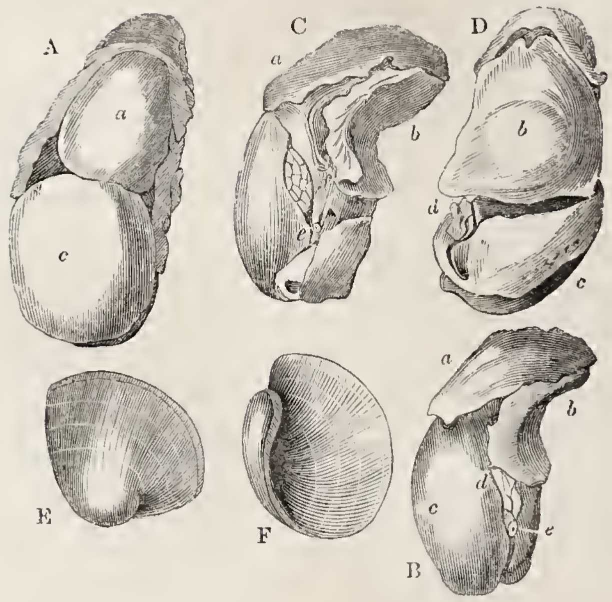
* Lyell's 'Principles of Geology,' 8vo. ed., vol. iii. appendix 1.

† The specific names 'cylindrica' and 'cylindracea' are so nearly alike, that we fear there will still be confusion.

2665.—Siphonaria.

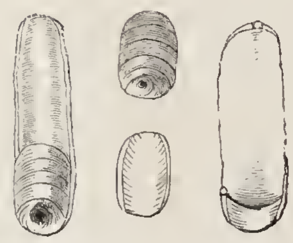
2666.—Siphonaria.

2669.—Ferussac's Bullæa.



2668.—Patulous Bullæa.

2673.—Globose Bulla.



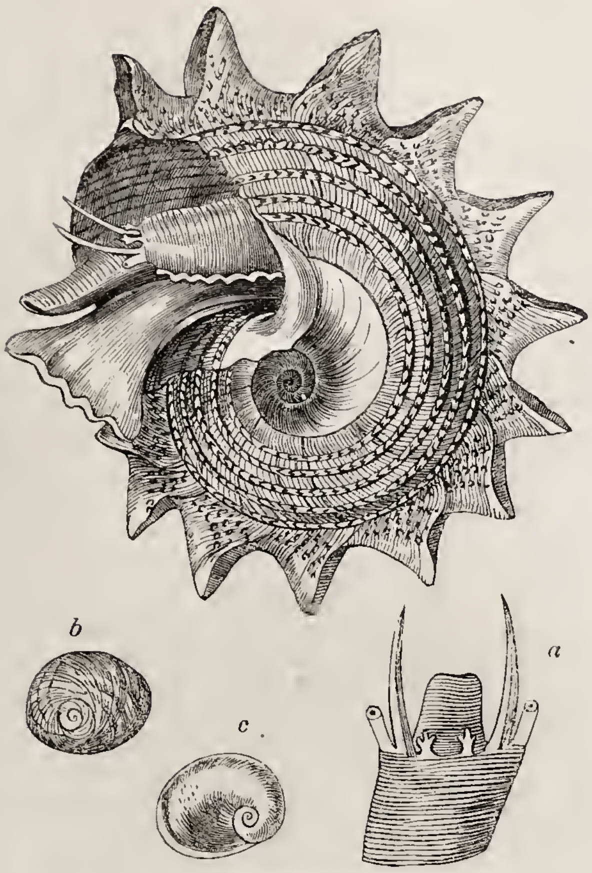
2670.—Adanson's Sormetus.

2674.—Meckel's Gasteroptera.

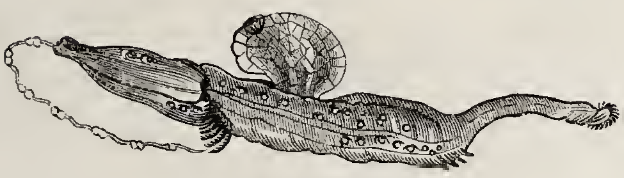
2671.—Fragile Bulla.

2672.—Belted Bulla.

2667.—Fleshy Lobaria.

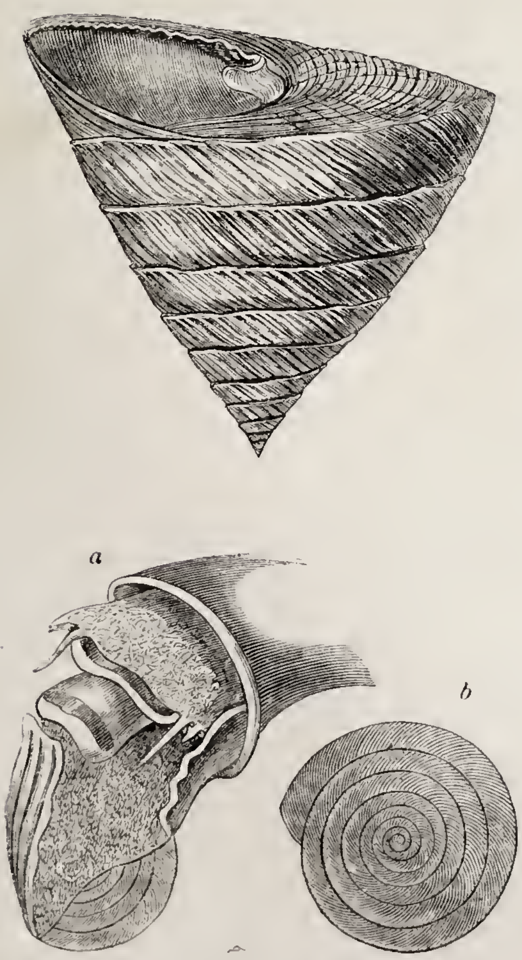


2680.—Imperial Trochus.

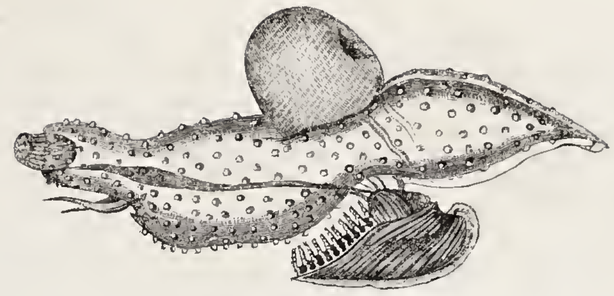


2678.—Firola.

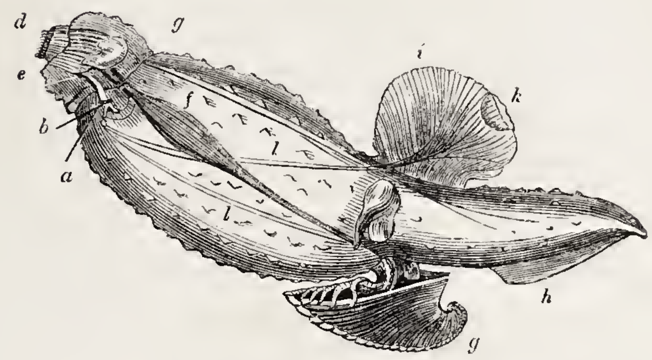
2677.—Peron's Atlanta.



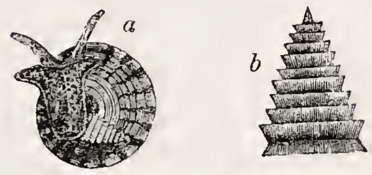
2679.—Obelisk Trochus.



2676.—Carinaria.

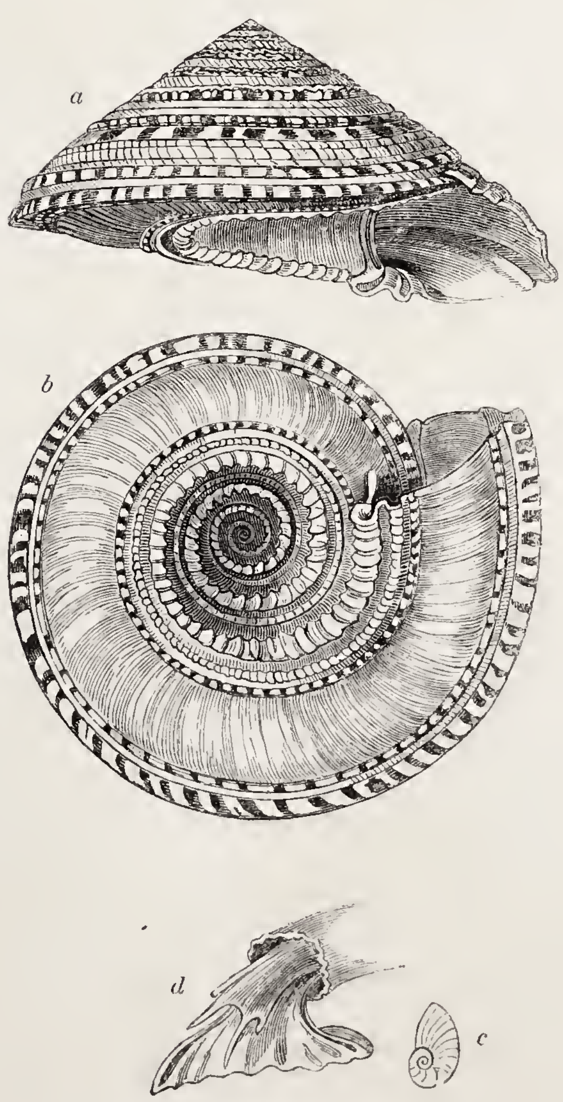


2675.—Mediterranean Carinaria.



2683.—Variegated Solarium.

2682.—Variegated Solarium



2681.—Perspective Solarium.

and, consequently, the desirableness that persons who have the opportunity should make coloured drawings from the living animals, as a means of giving a correct idea of the form and tints of these mollusks, before contracted and discoloured by the alcohol in which they are generally preserved.

ORDER HETEROPODA.

The mollusks of this order are distinguished by the structure of the foot, which, instead of forming a horizontal disc, is compressed so as to constitute a vertical muscular paddle, serving as a fin. At the edge of this, in many species, is a dilatation in the form of a hollowed cone, representing the disc in other orders. The branchiæ, which are plume-like tufts, are situated on the hinder part of the back, directed forwards; and immediately behind them are the heart, the liver, and other viscera. The body is gelatinous and transparent, with a muscular investment, elongated and generally terminating in a compressed tail. The mouth is furnished with a muscular tube, and a tongue armed with minute hooks. In swimming, the body is generally reversed, the paddle-like foot being uppermost, the back downwards.

These animals are capable of distending their body by filling it with water, in a manner not very clearly ascertained.

Cuvier observes that Forskal comprehended all the species under the genus Pterotrachea, which is now greatly subdivided.

2675.—The Mediterranean Carinaria

(*Carinaria Mediterranea*). In this genus the branchiæ, the heart, the liver, and other organs appear as if distinct from the general mass of the body, and are protected by a delicate shell, somewhat resembling that of the Paper Nautilus (Argonauta), seen in our figure as reversed, the back being downwards.

This shell is no protection to the body generally, being too small for the reception of the animal. The general form of the animal is subcylindrical and elongated. The whole mass is transparent, and dotted with elevated points. The tail is furnished above (or below, as the animal floats) with a sort of fin, which performs the part of a rudder.

The foot is a reddish, thin, compressed, and fan-like paddle, beautifully reticulated by muscular fibres crossing each other; and furnished with a sort of sucker, by means of which it cannot be doubted that the mollusk is enabled to adhere to rocks or stones, thus mooring itself whilst reposing at the bottom of the sea.

The mouth is a retractile muscular tube, furnished with a rasp-like tongue, and the course of the œsophagus, stomach, and alimentary canal is easily seen through the transparent parietes of the body.

Referring to Fig. 2675, *a* shows the situation of the œsophageal ganglion; *b*, the eye; *c*, the head; *d*, the retractile tube of the mouth; *e*, the tentaculum; *f*, the digestive tube; *g*, the shell, containing the organs of respiration, &c.; *h*, the posterior or rudder fin; *i*, the ventral fin; *k*, the sucker of the ventral fin; *l l*, the nerves.

The present species of Carinaria is a native of the Mediterranean, and specimens have been taken in the Indian Ocean: hence it would appear to be very widely spread. There are, however, others, as C. Cymbium, C. fragilis, &c., all natives of warm latitudes. Fig. 2676, copied from the Iconographie of Cuvier's 'Animal Kingdom,' represents Carinaria, with the back uppermost. It is there denominated C. Cymbium; but in all probability it is C. Mediterranea.

2677.—Peron's Atlanta

(*Atlanta Peronii*). Peron's Atlanta is a minute mollusk, as transparent as crystal, with a most delicate shell spirally rolled on itself, and not unlike an ammonite in form, inhabiting the Indian seas. Referring to Fig. 2677, *a* represents this mollusk, of the natural size. M. Lamanon thought that in this mollusk he had discovered the original of the fossil ammonites ('Voyage de la Peyrouse,' iv. p. 134, pl. 63); but in this view he was decidedly mistaken, as it is incontestably proved that those fossil shells belonged to cephalopodous mollusks.

2678.—The Firola

(*Firola Frederici*). Excepting that there is no shell, the Firola closely approaches to Carinaria: the mouth is situated at the extremity of a long proboscis; and at the end of the tail a long jointed thread is often to be observed, the nature of which, says Cuvier, is not ascertained. Forskal considered it a distinct parasitic animal. The Firolæ are common in the seas of the warm or temperate latitudes, and are remarkable for their extreme transparency, which is often interrupted by golden spots.

From their delicacy, which renders them liable to mutilation, it is not very easy to procure perfect specimens of these singular mollusks, and consequently the determination of the species is not always practicable.

From the genus Firola Lesueur separates two others, Firoloïda and Sagitella, but upon very trifling grounds.

ORDER PECTINIBRANCHIATA.

The Pectinibranchiata form the most extensive division by far of the Gastropodous mollusks, comprehending almost all spiral univalves, and many simply conical shells. The branchiæ consist of numerous leaves or strips ranged in parallel order like the teeth of a comb, and are attached in one, two, or three lines, according to the genera, on the ceiling of the pulmonary cavity, which occupies the last whorl of the shell, and opens between the edge of the mantle and the body. A great difference exists between the Pectinibranchiata, in the presence or absence of a tube formed by a prolongation of the edge of the pulmonary cavity of the left side, and which emerges through a canal or notch in the shell, in order to enable the animal to carry on aquatic respiration while shrouded in its domicile. There is another point of distinction between these mollusks, viz. that some are destitute of an operculum for closing the mouth of the shell, and moreover they vary in the fringes and other appendages of the head and body. In all, however, there are two tentacles, and two eyes, supported sometimes on peculiar peduncles. The mouth is trumpet-shaped, more or less produced, and furnished with a tongue armed with minute hooks, and so forming a rasp capable, by repeated working, of piercing the hardest bodies.

The Pectinibranchiata are ranged into many families, according to the form of their shells, which appear to have a constant relationship to that of the animals themselves.

Family TROCHIDÆ.

The mollusks of this family, according to Cuvier, are distinguished by the shell having an entire aperture, without notch or canal for a mantle siphon, or pulmonary tube, the animals being destitute of such siphon; and by the possession of an operculum, or some organ in lieu of it.

2679.—The Obelisk Trochus

(*Trochus obeliscus*). The genus Trochus is characterized by a shell of which the angular aperture approaches at its external border more or less to the totality of a quadrangular figure, and is on an oblique plane with reference to the axis of the shell, because that part of the border next the spire advances more than the rest. The greater number of these animals have three filaments on each side of the mantle, or at least some appendages at the sides of the foot. The species are very numerous; they are marine, and feed upon plants; their range is very extensive, few seas being without some of them. They are found at various depths, from the surface to forty-five fathoms, creeping on rocks, sandy beds, masses of sea-weed, &c. M. Deshayes enumerates a hundred and three existing species, but this is under the mark.

The Trochus obeliscus is a native of the Indian seas; it was found by MM. Quoy and Gaimard at Tonga. The shell is conico-pyramidal, coloured with green and white; the whorls are more or less tuberculate, nodose, obliquely furrowed across; the lower surface is planulate. The mollusk has stout short tentacles: the eyes are on large pointed pedicles; the muzzle is wide, with a black riband near its border; the head is dotted with greenish; the foot is yellow below, and thickly sprinkled above with dusky brown. The edge of the mantle is variegated with brown and greenish; the fringes of the foot are white.

Referring to Fig. 2679, *a* shows the anterior part of the mollusk, and a portion of the operculum, which is visible at the lower part of the figure; *b* is the operculum removed to show its structure.

2680.—The Imperial Trochus

(*Trochus imperialis*). This is a very rare species, and has hitherto been found only at New Zealand. Quoy and Gaimard never obtained more than one living specimen, of small size, which was found in the Passe des Français, Tasman's Bay. The shell was covered with calcareous incrustations and marine plants, indicating the indolent habits of the animal.

The shell is orbicularly conical, the apex obtuse; the whorls turgidly convex, squamoso-radiate at the margin. Colour above violet brown, white below. In the mollusk the muzzle is elongated in the form of a proboscis; the tentacles are short; the ocular peduncles stout and obtuse. The operculum is oval, smooth and whitish. Referring to Fig. 2680, *a* represents the anterior part of the animal seen from above; *b*, the inside of the operculum; *c*, the outside of the same.

2681.—The Perspective Solarium

(*Solarium perspectivum*). Trochus perspectivus, Linn. The genus Solarium is distinguished by the spire of the cone being very wide; the base presents an extensive umbilicus, in which the eye may follow the inner border of all the whorls, marked with a crenulated cordon.

The species included in this genus have been found in the seas of warmer latitudes. They occur respectively in the Mediterranean, the Indian Ocean, in the South Seas, off the coasts of Tranquebar and those of New Holland. Most appear to be littoral in their habits, keeping near the shore, on banks or rocks covered with marine vegetation. Upwards of twelve species are recorded.

In Solarium perspectivum the shell is orbicularly conoid, longitudinally striated, yellowish white, with articulated belts of white and brown near the sutures; the notches of the umbilicus are small.

The mollusk has a large foot widened in front, with a very strongly developed marginal furrow. The head presents a large escutcheon: the tentacles are short and stout; at their base are placed the eyes on short peduncles. The operculum is large, oval, and membranous. Referring to Fig. 2681, *a* represents the front view of the shell; *b*, the shell as seen from below; *c*, the operculum; *d*, the anterior part of the animal.

2682.—The Variegated Solarium

(*Solarium variegatum*). This species, of which specimens were procured by MM. Quoy and Gaimard in Carteret Harbour, New Ireland, is of small size, with an orbiculate convex shell transversely sulcated, longitudinally striated, variegated with white and bay. The umbilicus is patulous and crenulated.

This mollusk is remarkable for an operculum of most singular form, which it carries at the posterior part of the body, and which differs from that of all other species. Previously to the discovery by MM. Quoy and Gaimard, with respect to the mollusk to which it belonged, it had been known to conchologists by the account of M. de Roissy, but all was uncertainty as to the species to which it was to be referred. It is a long solid calcareo-membranous cone, carrying membranous lamellæ spirally throughout its length. The interspaces appear as if ribanded. It does not enter completely into the shell, but well fills the aperture. At Fig. 2683, *a* represents the animal and shell of Solarium variegatum, together with the operculum seen from below; *b*, the operculum removed.

The fossil Trochi and Solaria are very numerous; and as we have unfortunately so little to say of the habits and manners of the recent species, it may not be amiss to enter into the distribution of the fossil species, as recorded by different geologists, to whom the study of conchology is of the highest importance. We shall take Trochus and Solarium separately.

Trochus.—M. de Blainville states that Lamarck enumerates nine fossil species, and Defrance fifty-six, eleven of which the last-mentioned zoologist considers as analogous: six are from Italy, and thirty-eight from Grignon.

Mr. G. B. Sowerby observes that the fossil species, which are rather numerous, belong to the newer formations, such as the crag, the calcaire grossier, and the green-sand: they are also, he adds, found in the London clay, and he remarks that he has reason to believe that some species occur so low down as the lias.

The number of fossil species of Trochus recorded by M. Deshayes in his tables is seventy (tertiary); and of these Trochi magus, fagus, cingulatus, agglutinans, Adansoni, conulus, cinerarius, conuloides, Matoni, zizyphinus, strigosus, and obliquatus, are given as species found both living and fossil (tertiary). Trochus crenulatus is noted among those species which are found in more than one tertiary formation, but does not occur in the living and fossil list. Mr. Lyell, however, under the head of 'Fossil Shells collected by him in Ischia, and named by M. Deshayes,' mentions Trochus crenulatus as one of four shells sent to him from Ischia, all of recent species. Mr. Lyell enumerates also, among the fossil shells from the western borders of the Red Sea, collected by Mr. James Burton, and communicated by Mr. G. B. Greenough, Esq., Trochi maculatus, virgatus, and mauritianus, all described as recent by Lamarck. Among the fossil shells collected by him at Sienna, he notices Trochus fermonii, and a new species, with its colour. ('Principles of Geology.')

That Trochus occurs below the chalk appears from Dr. Fitton's valuable list, where Trochus Sedgewickii is recorded both from the upper green-sand

of the Isle of Wight and from the Oxford oolite in Dorsetshire, and another uncertain species from the last-named locality. See this list also for localities of Pleurotomaria. ('Strata between the Chalk and Oxford Oolite.')

Nor is it wanting in the Silurian rocks, where Mr. Murchison records the presence of the genus in the old red sandstone (middle and lower beds only), in the upper Ludlow rock, and (with a ?) in the Caradoc sandstone. In the same elaborate work Pleurotomaria is noted from the lower Ludlow rock and from the Caradoc sandstone. ('Silurian System.')

Solarium.—M. de Blainville observes that Lamarck records eight fossil species, and Defrance seventeen, some of which are subanalogues from the calcaire grossier. M, de Blainville also notes the fossil Solarium magnum (Maclurite) from North America, and adds that Defrance enumerates eight species of Euomphalus (fossil).

Mr. G. B. Sowerby observes that a few fossil species occur in the tertiary beds; and that there are some fossils belonging to the lower beds of oolitic formation, and even as low as the mountain limestone, which resemble them very nearly: these, he adds, form the genus Cirrus of some authors, and do not appear to him to possess any characters by which they may be generically distinguished from the Trochi, Turbines, or Solaria.

M. Deshayes, in his tables, makes sixteen the number of fossil Solaria (tertiary), and names Solaria variegatum, carocollatum, and pseudo-perspectivum as species found both living and fossil (tertiary).

In the list of Red Sea shells above referred to Solarium perspectivum appears.

That the genus occurs below the chalk is evident from Dr. Fitton's List, also above referred to, where three species are recorded from the upper greensand, the gault, and Blackdown. Cirrus is also noted from the upper green-sand of Dorset.

Solarium does not appear among the fossils of the Silurian rocks, but no less than nine species of Euomphalus are recorded in Mr. Murchison's tables, coming respectively from the Aymestry limestone, the lower Ludlow rock, the Wenlock limestone, the Wenlock shale, the Caradoc sandstone, and the Llandeilo flags.

These works are only quoted as examples out of many fossil lists which should be examined by the student.

Here may be best noticed the Rotella mana (from the Claiborne beds, Alabama, tertiary) of Mr. Lea, who observes that he is not aware that the genus Rotella has before been observed in a fossil state in America or in Europe, and refers to the tables of M. Deshayes, who gives four recent species, but none fossil. ('Contributions to Geology.')

Family TURBINIDÆ.

In this family, according to Cuvier, are comprehended all the species with the shell completely and regularly turbinated, and with the mouth entirely circular. The subdivisions or subfamilies are numerous.

The species included in the genus Turbo, Les Sabots of the French, are described by the same author as having the shell round or oval, thick, and with the mouth completely on the side of the spire by the penultimate whorl. The mollusk has two long tentacles, with the eyes carried on peduncles at their external base; on the sides of the foot there are membranous wings or expansions, which are sometimes simple, sometimes fringed, sometimes furnished with one or two filaments. It is to some of these species that those thick, solid, calcareous opercula belong, which are remarkable in collections, and which were formerly employed in medicine under the name of Unguis adoratus. Some species, he adds, are umbilicated (Meleagris, Montf.), and others not umbilicated (Turbo, Montf.).

M. de Blainville, in reference to the Turbinidæ (genus Turbo of Linnæus), gives the following general characters:—

Animal slightly variable, rather, however, with reference to the form and proportion of certain external parts than to the totality of its organization, and bearing a great resemblance to that of a Trochus.

Shell equally variable in its general form, but with the aperture always nearly circular and completely closed by a calcareous or horny operculum; the spiral whorls are few, and the apex is sublateral. M. de Blainville in further observations remarks, that in reality there is very little distinction between this family and the Trochidæ, and that, in fact, the Linnæan genus Trochus is fused by insensible gradations into the Linnæan genus Turbo; and he adds, that it is only with a view of making the conchological system of Linnæus accord with that of modern authors that he has established the present family.

With respect to the habits and manners of the Turbinidæ, it would appear that they frequent submarine banks covered with sea-weeds, and are all phytophagous, or vegetable feeders; a few are natives of fresh waters, and a limited number respire air. With respect to the restricted genus Turbo of modern naturalists, M. de Blainville thus characterizes it:—

Animal nearly resembling that of the Trochi; the sides of the body are frequently ornamented with tentacular appendages varying in form and number. The head is prolonged into a proboscis; the tentacles are slender and setaceous; the eyes often subpedunculate; the mouth is without a labial tooth, but provided with a very long lingual riband rolled spirally and contained in the abdominal cavity; there is a transverse furrow at the anterior border of the foot; two branchial pectinations; shell thick, nacreous, internally depressed, conical or subturriculate, sometimes umbilicated, and sometimes slightly carinated on its circumference; aperture circular or slightly depressed; the operculum is calcareous or horny, and in the latter case the spire is visible on the outer side, but in the calcareous opercula the spire is visible on the internal side. M. de Blainville divides the genus Turbo into ten sections for the sake of convenience.

With regard to the internal anatomy of the mollusks of the genus Turbo, MM. Quoy and Gaimard have entered fully into details, which it would be here out of place to follow. See the atlas of the Astrolabe (Zoologie, pl. 59, f. 10).

2684.—THE MARBLED TURBO

(*Turbo marmoratus*). This large and beautiful shell is well known to conchologists, and is a native of the Indian seas. Living specimens were brought to the Astrolabe at Amboyna, by the Malays, but MM. Quoy and Gaimard were unable to obtain any account of the habits of the animal. It would appear that the mollusk is used as food by the natives of Wagiou, and those voyagers often found the empty shells of this turbo upon the heaps of other molluscous shells from which the inhabitants derive a great portion of their subsistence.

The shell is subovate, very ventricose, imperforate, smooth, of a green colour, marbled or subfasciated with green and white; the last whorl is transversely nodulous in a triple series, the upper nodules the largest; the lip at the base is flattened into a short subreflected process: the mouth silvery. This shell, when deprived of its external layer, exhibits a silvery, iridescent, and very beautiful nacre. The operculum is white externally, chestnut internally.

Referring to Fig. 2684. *a* represents a back view of the shell; *b*, a view of the shell, presenting the mouth, with the operculum in situ; *c*, the inside of the operculum.

2685.—THE TWISTED TURBO

(*Turbo torquatus*). This is a large shell, orbiculate-convex, broadly and deeply umbilicated, transversely sulcated, substriated with close-set longitudinal lamellæ, of a green grey colour. The spire is blunt at the apex. The shell when deprived of its first layer is beautifully nacreous.

According to MM. Quoy and Gaimard the foot of the mollusk often assumes a quadrilateral form, but it can elongate itself into a trumpet-shape. It is yellow below, dotted with reddish brown on the lateral parts.

This species inhabits King George's Sound, but few living specimens were found by the French voyagers.

Referring to Fig. 2685, *a* represents the shell with the animal seen from below, the foot assuming a quadrilateral form; *b*, the animal removed from the shell, with the foot trumpet-shaped; *c*, the outside of the operculum; *d*, the inside of the same.

2686.—COOK'S TURBO

(*Turbo Cookii*). The general form, ridges, imbrications, and markings of this beautiful shell are so well expressed by the figures, as to relieve us from the necessity of entering into a minute description, rather perplexing from the terms employed by conchologists than conveying clear and precise ideas to the general reader. It is in fact not very easy to express in words the details of a shell, though the eye at once seizes them; nor do the compound words derived from the Latin, as orbiculate-convex, imbricato-squamous, and the like, serve except for the professed naturalist; and though we have occasionally used such terms, we have at the same time felt that to most they would convey but little information. One of the difficulties indeed under which the naturalist labours in his attempts to describe the form and structure of objects popularly, arises from the circumstance that the terms he uses are either not in common use, being coined as it were to meet the necessities of science, or if used are not so in the sense in which he employs them. In fact the student in zoology and botany has to familiarize himself, as a preliminary step, with a list of scientific terms, used in a peculiar sense, which, when once understood, he perceives to be definite and expressive, but which constitute as it were a language *per se*, and to others destitute of meaning. With regard to shells we have greatly felt this difficulty, and the more so as, by way of relief to these dry and perhaps repulsive details, we can say so little of the habits and manners of their mollusks. On the contrary, quadrupeds, birds, reptiles, and fishes, from the variety of their instincts and modes of life, from their activity, their operations, their change of place, and their external structure, diverse for given ends, afford inexhaustible materials for descriptions replete with interest. Yet is the study of shells and their occupants of great importance, signally so indeed to the geologist, who at every step has to determine the affinity of extinct fossil species to those now existing, to trace the gradual approach of forms long passed away, through successive periods, to those now tenanting the waters of our globe; and is thereby enabled to amass a fund of materials, giving him the power of determining the difference or agreement of strata in various parts of the globe, and their respective ages. To the anatomist again the molluscous occupants of these external skeletons, as they may be considered, offer a boundless field of investigation, and present him with examples of wonderful and interesting organization. Hence is the term Conchology almost abandoned, and the term Malacology (μαλακος, soft, in allusion to the mollusks, and λογος) generally adopted in its room.

"The shell-collector of former days," says an eloquent writer, "looked upon his drawers, if they were rich in rare species or varieties, as containing an assemblage of gems; and indeed the enormous prices given for fine and scarce shells, joined with the surpassing beauty of the objects themselves, almost justified the view which the possessor took of his cabinet of treasures. They were to him really 'Les Délices des Yeux et de l'Esprit;'* and the energetic zeal with which he collected and the sacrifices that he made to procure a fine and perfect Many-ribbed Harp, a Gloria Maris, or Cedo Nulli, among the cones; an Aurora or Orange-Cowry, a Voluta aulica or Voluta Junonia, &c., were only comparable to the extravagances of those visited by the tulip mania when it was at its height. But though they were the delight of his eyes, they were, in nine cases out of ten, little more to the owner of them: they were mere trinkets on which he looked dotingly without knowing, and scarcely wishing to know, the organization of the animal whose skeleton only was before him. This innocent trifling came at last to be viewed in its true light by some collectors worthy of better employment, who put off childish things and went deeper into the subject. Lister, Adanson, Linnæus, Poli, Cuvier, Lamarck, De Blainville, and others gave dignity to this department of zoology, and gradually raised the science to its proper rank; whilst the comparatively imperishable nature of the covering of the testaceous mollusks became, in the hands of such men as William Smith and his followers, among the most valuable records by which the stratification of the earth's crust could be demonstrated and its geological history deciphered."

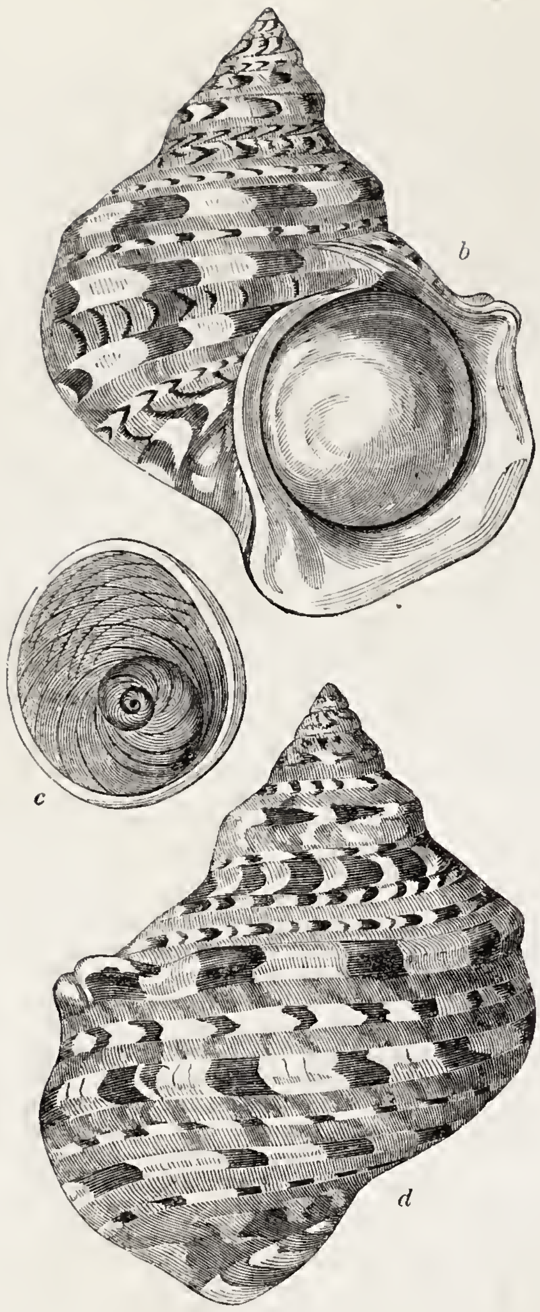
But we must return from this digression to the species of Turbo before us.

The Turbo Cookii was found by MM. Quoy and Gaimard in great numbers in Tasman's Bay, New Zealand, in the Bight of the Astrolabe (l'Anse de l'Astrolabe), and on the reefs of the Passe des Français. These scientific explorers observe that we may judge of its small degree of locomotion from the dirty incrustation, so difficult to be removed, with which the shell is covered. It grows to a considerable size.

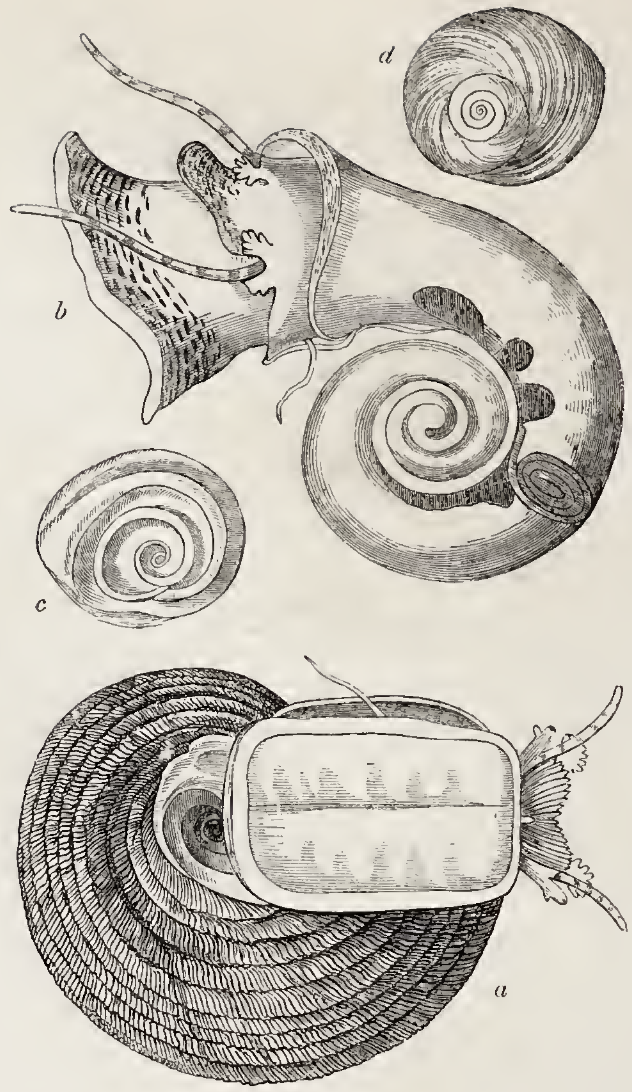
A common form of the Turbinidæ, with which all are familiar, is the ordinary Periwinkle, Le Vogneau of the French (Littorina vulgaris, Féruss.), Turbo littoreus, Linn. This species abounds in rocky places in our seas, and is used as food, but is not very digestible, and has been known to occasion dangerous disorders. According to Pennant the Swedish peasants believe that when these shells creep high up the rocks, they indicate a storm from the south. Linnæus quotes Stroem, the Norwegian, for a different augury; when it ascends the strand it indicates an approaching land-wind, and a calm in-shore. A species in the hotter seas, Littorina pulchra, has been found on mangrove-trees fourteen feet above the water, and has been kept alive without water for six months. Another genus belonging, according to the opinion of MM. Quoy and Gaimard, to the present family, and indeed closely related to Turbo, is Phasianella.

The shells of the mollusks of this genus, once so rare, began, as these naturalists observe, to be of less value in consequence of Baudin's voyage; and

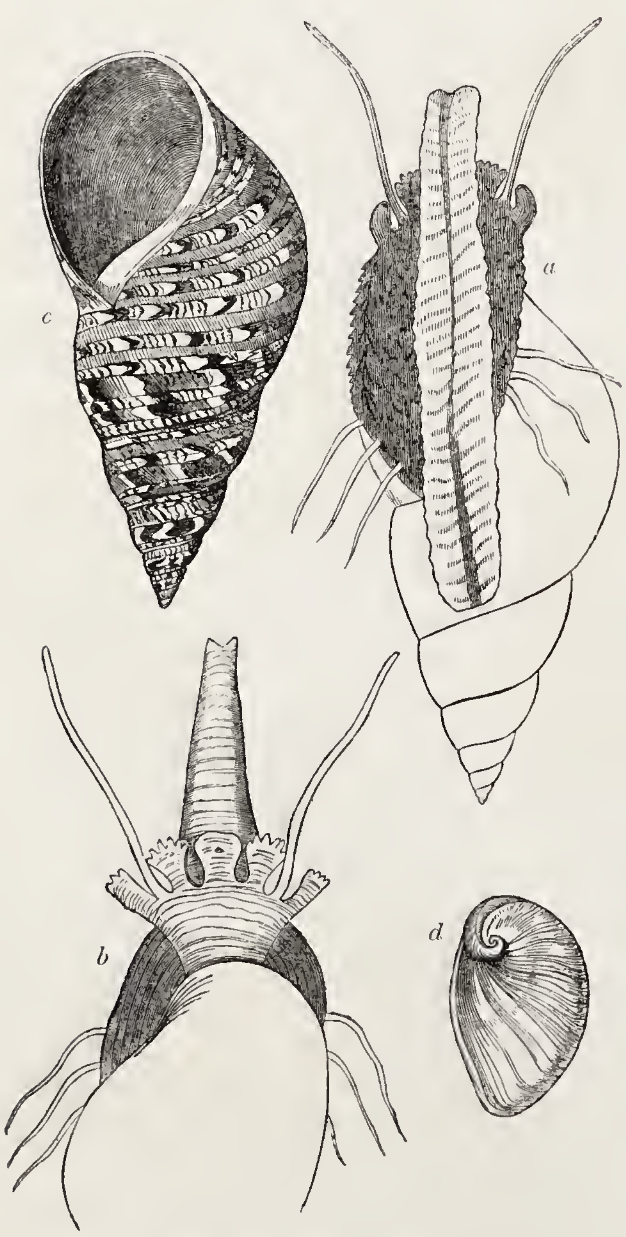
* The French title of Knorr's celebrated work in German and French. The German title is 'Vergnügen der Augen und des Gemüths,' 4to., Nuremberg, 1757, 1764.



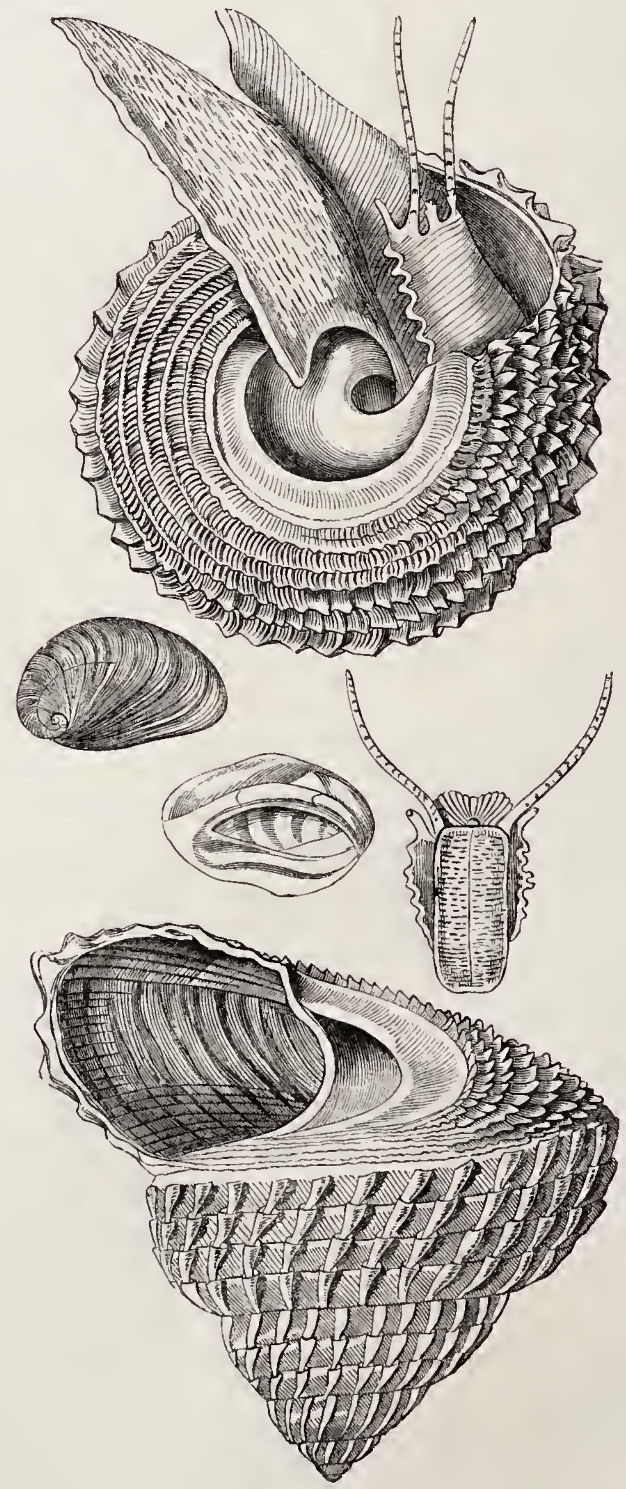
2684.—Marbled Turbo.



2685.—Twisted Turbo.

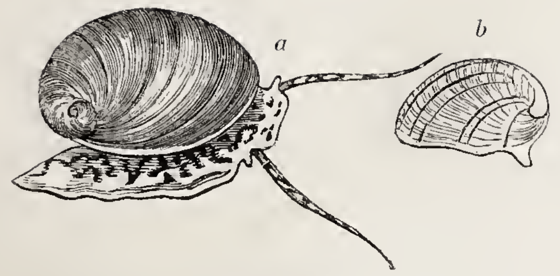


2687.—Bulimoid Phasianella.

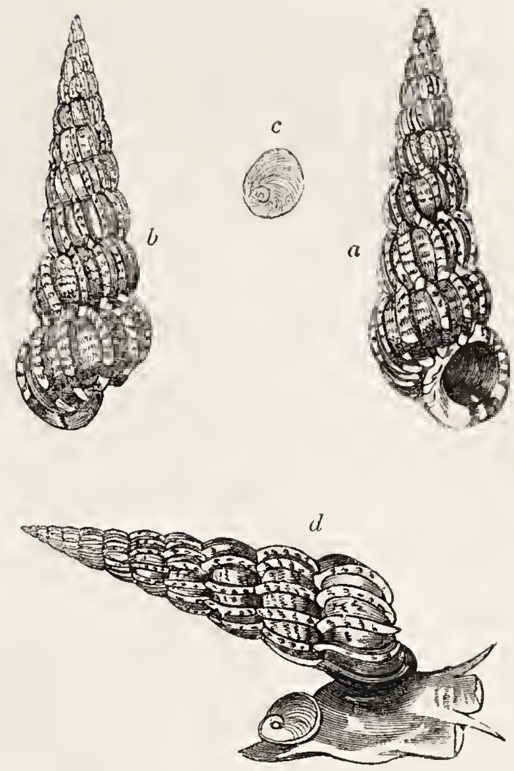


2686.—Cook's Turbo.

2688.—Roseate Turritella.



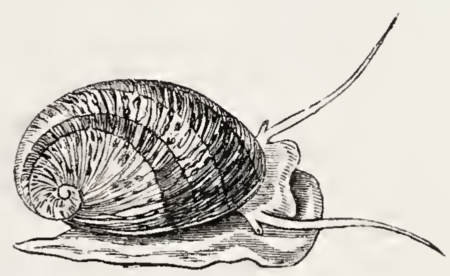
2694.—Neritina.



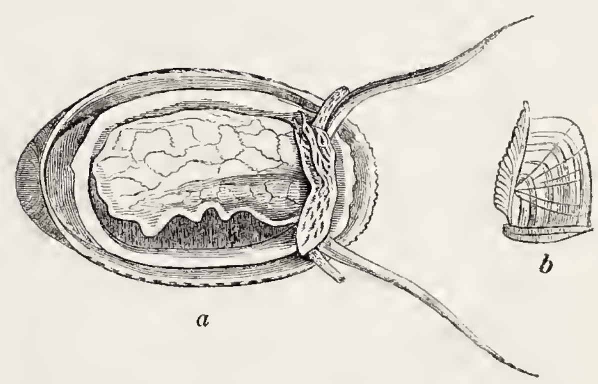
2690.—Common False-Wentletrap.

2689.—Awl-shaped Turritella.

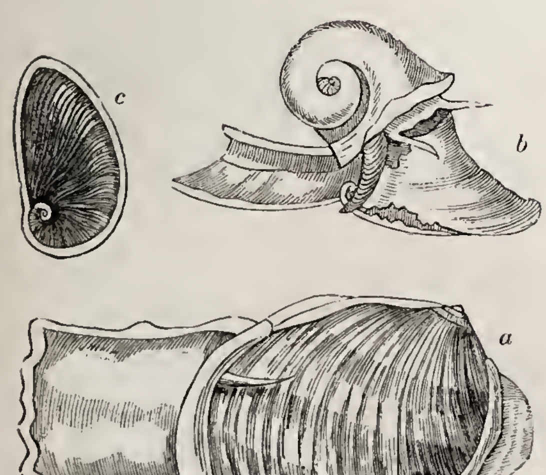
2691.—Royal Staircase Wentletrap.



2692.—Polished Nerita.



2695.—Elliptical Navicella.



2696.—Black-lipped Natica.

2693.—St. Ascension Nerita.

that of the Astrolabe has rendered them common. The place probably most frequented by them is, according to these zoologists, Port Western in Bass's Strait. They cover the sandy beaches of this vast tract. Each tide carries these mollusks to the shore, where they live high and dry for some hours, and endeavour to withdraw themselves from the heat of the sun by hiding under the fuci. Under such shelter they congregate so numerously that seventy-six were found under one of these plants.

The Phasianellæ, observe the same zoologists, are always smooth. This polish, and, still more, their continual movements, prevent them from being covered with Serpulæ, Flustræ, and other parasites which encrust sluggish shells. Their agitation, however, makes it difficult for them to preserve the contour of their aperture perfect, for it is very frail. In millions of individuals MM. Quoy and Gaimard always found the lip trenchant, never thick or with a border.

The species appeared to them very difficult to characterise, both with regard to the animal and the shell. The last especially presents so much diversity of colour, and sometimes of form, that one may be deceived, and advance simple varieties to the rank of species. MM. Quoy and Gaimard saw some of these shells, which were brown and greenish during life, become red after death by the solar action, &c.

The most common tint of these mollusks is stated by them to be brown dotted with greenish. This colour is proper to those whose shells are nearly of a similar hue; whilst those which approach white or are speckled with red have the animal of a grass-green.

These are lively active animals, and voracious withal, for they were taken in nets baited with flesh let down into the sea. Their foot, endowed with great mobility, is elongated like a proboscis: its great peculiarity is its faculty of moving in two portions as it were, that is to say, each of its sides advances separately and successively; and a longitudinal gutter may be perceived on its lower surface.

On the coasts of New Holland, the Phasianellæ found at King George's Sound are larger and less numerous than at Port Western. They are few in number on the coasts of Van Diemen's Land. The operculum is always calcareous.

2687.—The Bulimoid Phasianella

(*Phasianella bulimoides*). The shell of this species is oblong-conical, smooth, pale yellow, transversely banded; the bands frequent and diversely variegated and spotted; spire acute at the apex.

The animals are generally of a fine green nearly throughout. One will have more white dots on the foot, and another a violet or reddish spot on the lateral fringes of the foot; a third will have this organ yellowish and slightly fringed upon the borders. In all the tentacles are slender and long, the ocular peduncles stout and button-shaped, the palmettes laciniated. The muzzle, which is elongated a little in the form of a proboscis not retractile, can also modify itself into the shape of a rounded scutcheon (écusson). The fringes of the sides of the feet are very finely laciniated, and sometimes present brown ramifications of vessels; they carry three greenish filaments on each side.

The operculum is oval, calcareous, slightly convex, white, and covered for a portion of its contour by a fleshy lamina of the foot which supports it.

The Phasianella bulimoides is very common at Port Western, and larger at King George's Sound. MM. Quoy and Gaimard observe, that Lamarck indicates it as coming from New Zealand: this, they remark, is possible, but they never found any traces of Phasianellæ there.

Referring to Fig. 2687, *a* represents the animal and shell seen from below; *b*, the same seen from above; *c*, the shell; *d*, the operculum.

2688.—The Roseate Turritella

(*Turritella rosea*). In the genus Turritella, to which different positions have been assigned by various naturalists, the shell is turriculated, pointed, and generally striated in the longitudinal direction of the whorls of the spire, which are numerous: the aperture is rounded and entire.

The Roseate Turritella has the whorls almost smooth, and is of a roseate tint, which changes to brownish or dull reddish after the death of the mollusk. The animal has the muzzle elongated into a proboscis; the tentacles are moderately long and slender, carrying sessile eyes very near their base; the colour is brown dotted with black; the mantle has its margin fringed and sprinkled with whitish lunulate marks. The operculum is delicate, round, and multispiral.

This species was found in great numbers by MM. Quoy and Gaimard in the Bight of the Astrolabe, New Zealand, at the depth of several fathoms. They are timid animals, seldom protruding from their shells. Length nearly three inches: *a* represents the shell and animal; *b*, the operculum.

2689.—The Awl-shaped Turritella

(*Turritella terebra*). This species is found in the African and Indian Seas: the whorls are sulcated; the colour reddish.

Both living and fossil species of Turritella are very numerous: of the former M. Deshayes found twenty-four species, and of the latter, in tertiary strata, forty-five species.

Turritella, however, occurs in ancient formations, both anterior to and posterior to the chalk. See Dr. Fitton's 'Stratigraphical Table.' In this five species are recorded, ranging from the upper greensand to the Oxford oolite inclusive. Four species are described by Mr. Murchison as occurring in the middle and lower beds of the old red sandstone (Silurian rocks) and the lower Ludlow rock.

2690.—The Common False-Wentletrap

(*Scalaria communis*). The situation of the genus Scalaria has been varied by different naturalists according to their respective views: Cuvier places it near Turritella. The shell is subturriculate, with the whorls more or less close, and furnished with elevated longitudinal ribs. The operculum is horny. At least eighty distinct species are known; they are deep-sea shells, ranging from seven to thirteen fathoms in sandy mud. A section commonly called True Wentletraps are found in the seas of warm climates, but many of the False Wentletraps, as the other section is called, occur in the European seas and on our own coast. Of these the Scalaria communis is an example. The ribs in this species are rather thick, smooth, and suboblique. The general tint is whitish or pale fulvous, but a large variety occurs of a rosy violaceous tinge, with purple-spotted ribs: *a* represents the front view of the shell; *b*, the back view; *c*, the operculum; *d*, the animal with its shell.

2691.—The Royal Staircase Wentletrap

(*Scalaria pretiosa*). Aciona Scalaris, Leach; La vraie Scalata. This beautiful and highly valuable shell is a native of the Indian and Chinese seas. It is conical in general form, umbilicated, and contorted into a loose spire. The ribs are bold and apart. The general tint is pale yellow, with the ribs white. The term pretiosa was given to this shell by Lamarck from the great price which a good specimen would bring in the market, especially when it exceeded two inches in height. Such a specimen, we are assured, "has been sold in former days for 2400 livres, or 100 louis! But those times are gone by; the shell is no longer rare, and good specimens only fetch shillings where they once brought pounds. A very fine example, however, still commands a considerable sum. That in Mr. Bullock's museum, supposed to be the largest known, brought 27*l.* at his sale, and was in 1815 estimated at double that value." *a* represents a front view, showing the mouth; *b*, the back view; *c*, a view to show the whorls are disconnected.

We may now proceed to a group of shells consisting of the genera Nerita, Navicella, and Natica, which though they cannot, as an eminent naturalist remarks, be said strictly to belong to the Turbinidæ, are yet so far analagous to the forms which compose that family, that we may here bring them under notice. They form part of the family Neritidæ of Mr. Gray.

With respect to the genus Nerita of Linnæus, Adanson appears to have been the first who made known the animal inhabiting the shell, and Cuvier afterwards gave an outline of it in his 'Anatomie Comparée. In the 'Zoology of the Uranie' M. de Blainville added to our information; and MM. Quoy and Gaimard, who brought home numerous specimens, give some interesting details in the 'Zoology of the Astrolabe.'

They observe that the Nerits are marine or freshwater animals, a modification of habit which they think sufficient for establishing a simple division between these mollusks, which Lamarck erroneously in their opinion separated into two genera—Nerita and Neritina; for their organization is entirely similar. Thus the Neritæ, with a comparatively thick shell, which is very rarely furnished with an epidermis, are always found in the sea; and the Neritinæ of Lamarck, whose shell is more delicate and almost constantly covered with an epidermis, are always inhabitants of fresh water: a single instance of one of these Neritinæ having wandered into the sea, they may, they say, perhaps have had to cite. The Nerits have a particular and distinctive appearance: they pass a part of their life out of the water without ever removing to a distance from it. Those which haunt streams or marshes may adhere to the leaves of trees, but without going on land. Those which are found on land are carried there by Paguri (Hermit crabs), or by some accident. Marine Nerits are also seen at the mouth of rivers; and MM. Quoy and Gaimard remark that these are transitions which nearly all the mollusks undergo without suffering much.

MM. Quoy and Gaimard state that they were sometimes astonished to see these animals upon the black rocks, exposed to all the action of an equatorial sun without appearing to be affected by it. They owe this faculty of enduring heat to the circumstance of having previously taken in some drops of water which sufficiently refresh their branchiæ. This store, or what is left of it, they discharge when they are lifted from the rock.

The Nerits are very widely spread in warm climates. They are gregarious, and many species are found grouped on the same rock. Some love sheltered nooks, others are exposed to the fury of the waves: and, among those which haunt fresh-waters, some live in the deeps in the midst of the strongest currents; others, on the contrary, keep themselves in the slime of marshes. In their sufficiently agile movements their lips are constantly observed in motion.

The animal has a large head, a little notched in front, with two rounded lobes on the sides. The aperture of the mouth, which is subjacent to this sort of hood, is wide and plicated. The tentacles are always very long, pointed, and soft, carrying the eyes at their base upon a pedicle. The foot is oval, narrowed, a little pointed behind, wide in front, with a marginal furrow, and sometimes a depression, which gives it the appearance of being slightly lobated.

The edges of the mantle are fringed, so as to correspond with the internal furrows of the shell. There is no siphon. The pulmonary cavity is proportionally very large; a single, long, triangular, and pointed gill traverses it from left to right. It is free at its extremity. Its lamellæ appeared double to MM. Quoy and Gaimard. The heart is simple, placed backwards and to the left; its ventricle embraces the end of the intestinal loop, which has the appearance of traversing it.

2692.—The Polished Nerita

(*Nerita polita*). This species is distributed through nearly all the hotter seas. The shell is heavy, thick, and polished, and very finely striated longitudinally: the spire is very retuse; the lip toothed. It is marbled with blended tints, and often adorned with three red transverse bands; the animal is yellowish with dusky tentacles.

2693.—The St. Ascension Nerita

(*Nerita Ascensionis*). The shell of this species is solid, transversely furrowed, and ribbed, with the lip toothed; the aperture is white; the general colour of the shell yellowish grey, with brown marks upon the parts in relief. The foot of the mollusk is yellow below; striated and thickly dotted with brown on the sides, as is also the head above; the tentacles are streaked with black; the neck is violet. The operculum is reddish brown and granulated; a little projecting spur projects from its angle. *a* represents the shell and animal; *b*, the operculum.

2694.—The Neritina

(*Neritina pulligera*). Nerita pulligera. The shell of this fresh-water mollusk is ovate, and slightly striated; the outer lip is dilated and thin, the inner lip toothed. The general colour is chestnut brown; the inner lip yellowish; the outer white within. The operculum is green with black transverse bands. This species was found by MM. Quoy and Gaimard in the Island of Guam, and also at Vanikoro. They frequently observed on the trees dead shells of this species, with the spire always corroded, and inquire whether they had been brought there, or whether the animals had died after having ascended the trees. They further state as a remarkable circumstance, that in numerous individuals they found in the liver a small knot of parasitic worms, some of which were an inch and a half or more in length; they were pointed at both ends like lumbrici. At Fig. 2694, *a* represents the shell and animal; *b*, the operculum.

2695.—The Elliptical Navicella

(*Navicella elliptica*). The genus Navicella, except in the disposition of the operculum and in the muscular attachment of the animal to the shell, closely resembles Nerita. The operculum is very singular: it is placed above the foot; its form is somewhat quadrilateral, and is adherent throughout the extent of its lower surface; in its natural situation it seems as if contained in a sort of pouch between the foot and viscera, so that it cannot, as M. de Blainville observes, really serve the ordinary purposes of an operculum.

The shell is oval and elliptical, with a slight greenish brown epidermis, smooth, shining, and spotted with white and blue.

The Navicellæ, of which a limited number of species only is known, are fluviatile in their habits, and are natives of the Indian Archipelago.

Referring to Fig. 2695, *a* represents the animal in the shell, seen from below; *b*, is the operculum.

2696.—THE BLACK-LIPPED NATICA

(*Natica melanostoma*). The Naticæ are extensively spread in the warmer seas, and especially those within the tropics: they are abundant also along the coast of New Holland.

The present species was found by MM. Quoy and Gaimard, at the depth of several fathoms, near Torga and the Molucca Islands: other species were seen creeping near the shore on rocks and seaweed, and have been taken at various depths, from the surface to that of forty fathoms, on muddy banks in æstuaries and tidal rivers.

The shell of Natica melanostoma is thin, oval, convex, but depressed; the spire is slightly prominent; the colour is white zoned with yellow; lip blackish brown. The operculum is membranous and of a deep chestnut.

Referring to Fig. 2696, *a* represents the shell with the animal seen from above; *b*, the animal out of the shell; *c*, the operculum.

We now turn to a group of fresh-water shells, constituting a family termed Peristomians in the system of Lamarck, containing the genera Valvata, Paludina, and Ampullaria, but which are referred by Cuvier to the Turbinidæ. M. Deshayes indeed, commenting upon their organization, says, "it is evident that the genera which it (the Peristomian family) contains closely approach to those of the family of the Turbos; it would therefore be proper to place the Peristomians in the neighbourhood of the Turbinaceans, and to arrange them near the family of the Neritaceans, which has certainly less direct affinities with the Turbo family." Mr. Swainson regards these genera as forming, with some others, a subfamily of Turbinidæ.

2697, 2698.—THE VALVATA

(*Valvata piscinalis*). In the genus Valvata the shell is discoid and umbilicated, with the whorls rounded and distinct; the aperture is circular, and the operculum horny. The mollusk has a distinct head, prolonged into a sort of widened proboscis; the tentacles are long, with sessile eyes at the posterior side of their base. It would appear that the genus has hitherto been found only in Europe and America; about six species are known.

The Valvata piscinalis inhabits the ponds and rivulets of the British Islands and the adjacent continent. It is a minute shell of elegant contour.

At Fig. 2697, *a* represents the animal and shell of the natural size; *b*, magnified.

At Fig. 2698, *a* represents the shell of the natural size; *b* and *c*, magnified in two views; *d*, the operculum enlarged; *e*, glutinous masses of eggs on a leaf; *f*, a mass of eggs enlarged.

2699.—THE MINUTE PALUDINA

(*Paludina parvula*). In the genus Paludina the shell is conoid, with the whorls of the spire rounded; the aperture is oval; the operculum horny.

The mollusk is furnished with a proboscidiform mouth: the tentacles are conical, elongated, and contractile; the foot oval, with a marginal furrow at its anterior part.

The Paludinæ have generally delicate shells; the form is extensively spread; and species have been found in Europe, Asia, Africa, and America. The European are the inhabitants of temperate latitudes. M. Deshayes observes "that the greatest number of the species live in fresh waters, and that they are met with, in a great number of localities, on the earth's surface. They appear nevertheless to be more common in the northern than in the southern hemisphere." Some small species, he adds, live in brackish waters, where they are found in great abundance.

The number of recent species given in the tables of M. Deshayes amounts to twenty-five, and of these, three are also found to occur in a fossil state in tertiary formations. Referring to Fig 2699, *a* represents the animal and shell, in a side view, magnified; *b*, as seen from above.

2700.—THE VIVIPAROUS PALUDINA

(*Paludina vivipara*). Helix vivipara, Linnæus. This species, which is abundant in the rivers and fresh waters of our island, as well as of the continent, was regarded by Linnæus as a Helix, but Müller withdrew it from that genus and united it to Nerita. This error was afterwards rectified by Lamarck, who, aided by the anatomical researches of Cuvier, established the present genus and assigned to it the proper situation. The shell of this species is conoid, with rounded whorls, and diaphanous: it is smooth and generally of a greenish colour, with two or three purplish bands along the turn of the whorls.

What is very singular in the history of this species is, that it produces living young, clad in a delicate shell.

In its habits it closely resembles Limnæa and Planorbis. Fossil shells of this species occur in the Weald clay and Tilgate beds, as well as the lower divisions of the Hastings deposits (the Ashburnham beds).

Referring to Fig. 2700, *a* represents the shell of an adult with young shells in it; *b*, the operculum; *c*, the young shell before exclusion.

We now proceed to the genus Ampullaria, containing the apple shells of collectors.

In this genus the shell is globular, ventricose, and umbilicated, furnished with an epidermis; the spire is very short, and the last whorl larger than all the rest put together.

The aperture is oval. The operculum is horny or shelly. The mollusk has a large shield-formed delicate foot; the head is flattened, and terminated anteriorly by two buccal tentacles; there are besides two very long tentacles supporting at their base the eyes raised on peduncles. There is a long respiratory tube or siphon, projecting to a considerable distance, formed by the mantle, but impressing no furrow on the lip of the shell. The branchial cavity is very extensive, and the upper boundary is doubled so as to form a great aquiferous sac. Habits fluviatile.

The Ampullariæ frequent the lakes and rivers of warm climates. Species of very large size have been found in Asia, Africa, and America, and especially in the southern portion of the latter. Olivier states that one is found in Lake Mareotis in company with marine shells.

These fluviatile shells were arranged by Müller in his genus Nerita; and Linnæus classed some under the genus Helix.

2701.—THE DOUBTFUL AMPULLARIA

(*Ampullaria dubia*). The animal is represented creeping: *a* is the operculum; *b*, the right siphon; *c*, the left siphon.

The same species is represented at Fig. 2702, so as to show the lower side of the foot; the animal appears in the act of ascending to breathe, and with the respiratory siphon protruded. *a* is the operculum; *b*, the right siphon; *c*, the left siphon.

2703.—THE RAM'S-HORN AMPULLARIA

(*Ampullaria cornu arietis*). Ceratodes fasciatus, Guilding. A represents the animal creeping; B, the animal in a supine position; *a*, the operculum; *b*, the right siphon; *c*, the respiratory siphon; C, the head, tentacles, eyes at their base, and expansions at the side of the neck.

2704.—THE GLOBOSE AMPULLARIA

(*Ampullaria globosa*). This species is said by Mr. Swainson to be an inhabitant of the rivers of India. The shell is represented as having the mouth closed by the operculum. In this species the margin of the aperture is thick and grooved.

Ampullariæ have at various times been brought alive to Europe. An able naturalist informs us that the first, as it would seem, were sent to Paris, by M. Cailland, from the Nile. We learn that that naturalist, during his voyage to Meröe, collected several Egyptian Mollusca, which he distributed generously among collectors. One correspondent had been anxious for the fluviatile mollusks found in the Nile. The person employed to collect these, after having gathered a large quantity of river mollusca, among which were some living Ampullariæ, put them all into a box of bran (son). This box was delayed on its road by the operation of the quarantine laws for four months, and when it reached M. Caillaud, was in such a state, from the putrefaction of the greater part of its animal contents, that he hastened to throw the whole into the water. To his no small surprise he found, a few hours after, the greater part of the Ampullariæ, which had been shut up with this mass of putrefaction, quietly creeping about upon the mud. He gave many individuals to M. Deshayes, who kept them alive from four to five months. The latter zoologist remarks that, since that communication, Mr. Sowerby, in the 'Zoological Journal,' and M. Quoy, in the 'Zoology of the Astrolabe,' have given the figures of many other species of Ampullariæ, several of which have been brought alive to Europe. We know of no other figures of Ampullariæ in the 'Zoological Journal' than those illustrative of a paper by the Rev. Lansdowne Guilding.

On the 29th of October, 1833, Mr. Cuming, so well known for the great additions which he has contributed to our knowledge of the Mollusca by his collections from the west, and who has since been employed in the same laudable pursuit in the east, to the great enrichment of this department of zoology, brought to Mr. Broderip a specimen of Ampullaria globosa, expressing his opinion that it might be alive. Mr. Broderip immediately placed the specimen in a deep dish with some earth at the bottom, which was covered with New River water, and set it before the fire. On the 29th the animal gave no sign; but on the 30th it came forth and soon showed tokens of vigorous life. It was afterwards removed into a globular glass vase, such as is used for gold and silver fish, with a good layer of earth at the bottom. The water and earth were changed periodically, and the animal continued to live in apparently good health for many weeks. Its death was probably occasioned by the difficulty of resisting the low temperature of the long cold winter nights, where there were no stoves, in short nothing beyond the ordinary fires of a dwelling-house. The specimen is now in the museum of the Royal College of Surgeons.

M. Deshayes proceeds to observe that it became an object of inquiry how aquatic animals, unable to respire except by means of a pectinated branchia, could remain alive so long out of the element apparently necessary to their existence. Nearly all the persons, he remarks, who occupied themselves with this phenomenon, thought that the animal on retiring into its shell carried with it a certain quantity of water, which could not escape owing to the retention of the operculum, which closes the aperture with great exactness. Others thought that the humid air carried upon the branchiæ was sufficient to keep up the respiratory action. "Wishing to know," continues M. Deshayes, "whether there were anything in the structure of the animal which could explain the singularity, we soon perceived that the upper wall of the branchial cavity was doubled, and formed a great pouch, the aperture of which was placed backwards, above the origin of the branchiæ. Plunged in the water, the animal has this pouch constantly filled with the ambient liquid, and on retiring into its shell and shutting itself up under its operculum, this bag still remains filled with water, and thus furnishes the necessary materials for the function of respiration. Everything leads us to believe that this is the only cause which permits the Ampullariæ, pectinibranchiated aquatic animals, to remain a long time out of the water without perishing, and this explains also how it happens that in certain lakes which are annually dry Ampullariæ are always to be found. When the great heats approach and they plunge themselves into the mud or sand, they preserve in their branchial sacs the quantity of water necessary for them during the whole time of drought."

This, as a writer observes, is one of those beautiful provisions which meet the naturalist everywhere. The tropical torrent and lake may yield to the dry season and burning sun, but the Ampullaria, secure in the possession of his water-bag, can afford, like the camel in the desert, to wait till the rains furnish a fresh supply, and again fill the parched channel.

With respect to fossil species of this genus, Mr. G. B. Sowerby states that he is not certain of the existence of any; several, he adds, are mentioned by Lamarck, in the 'Annales du Museum,' among the fossil shells of the environs of Paris; others, which are thought to be genuine, are found in the London clay at Hordwell, and in the mixed stratum between the two fresh-water beds at Headen Hill, in the Isle of Wight. M. Deshayes is of opinion that many fossil species, referred to Natica, ought to find a place in the genus Ampullaria.

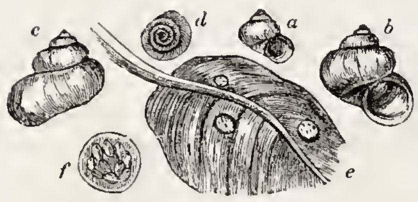
M. Deshayes goes on to state that up to the time when he wrote (1838) there have hardly been found any fossil species of Ampullaria about which there is not some doubt. Those shells which he has retained in the genus, from the character of the aperture and the small thickness of the shell, are, he says, never met with except in marine formations, and one may always suspect that the animals which produced them were different from those of the Ampullariæ properly so called. As these species have the characters of Ampullariæ, and we have no means of ascertaining the analogy of the animals, we are obliged to have recourse to the characters of the shells and to determine from them alone. But a little time since, he remarks, the belief was general that fossil Ampullariæ belonged exclusively to the tertiary beds; but it is now known that this genus occurs through all the "terrains de sédiment," for Mr. Sowerby has recorded a fine species in the transition beds, and M. Deshayes says that he knows many others in the oolitic series, and even in the lower chalk. (Last edition of Lamarck.)

The number of fossil species recorded by M. Deshayes in his tables is fourteen (tertiary). In the last edition of Lamarck the number is sixteen.

The genus occurs in the list of the fossils of Lower Styria, given by Professor Sedgwick and Mr. Murchison, in their valuable paper 'On the structure of the Eastern Alps' ('Geol. Trans.,' vol. iii. second series), and in Mr. Mantell's 'Tabular Arrangement of the Organic Remains of the County of Sussex' (ibid.).

In the last-mentioned catalogue Ampullariæ pa-

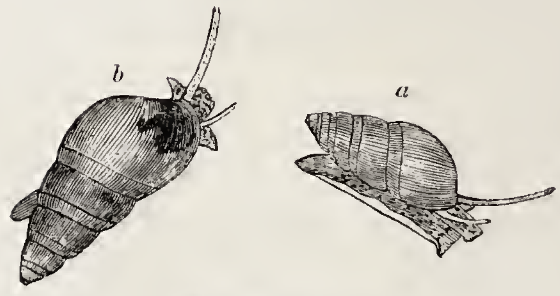
2702.—Doubtful Ampullaria.



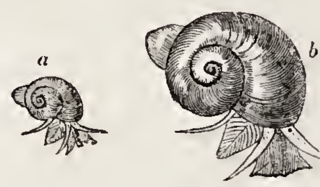
2698.—Valvata.

2703.—Ram's horn Ampullaria.

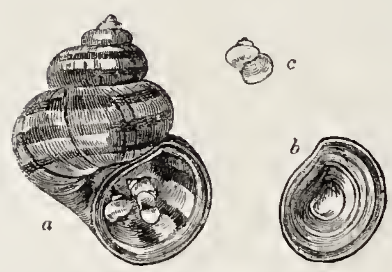
2704.—Globose Ampullaria.



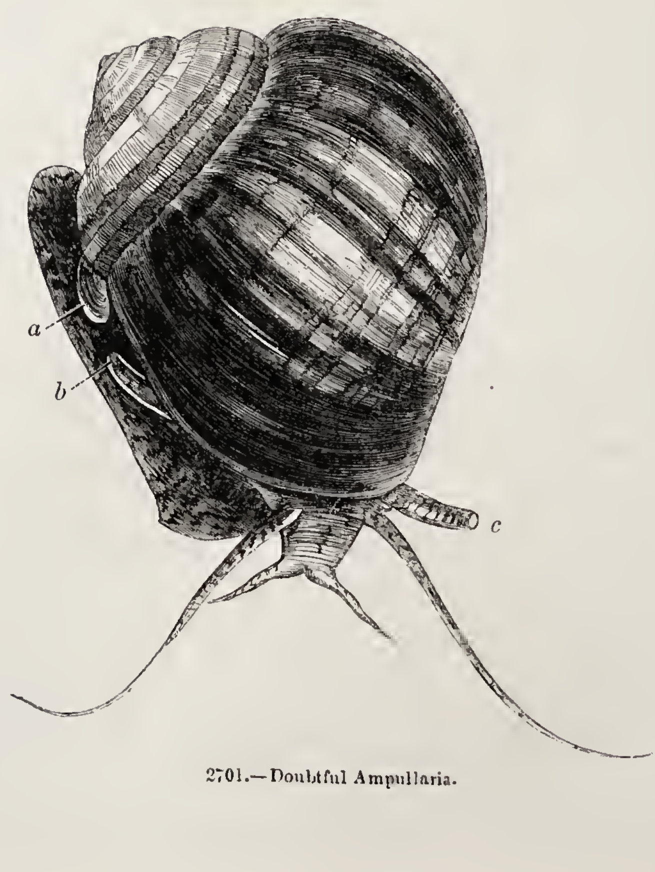
2699.—Minute Paludina.



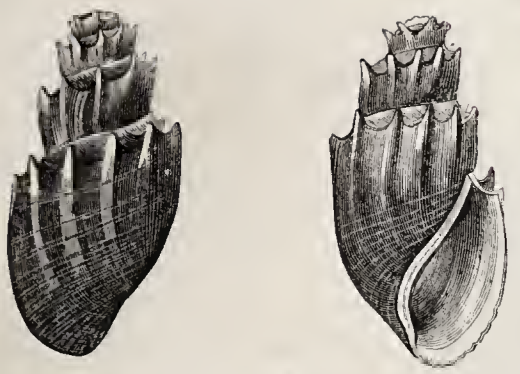
2697.—Valvata.



2700.—Viviparous Paludina.

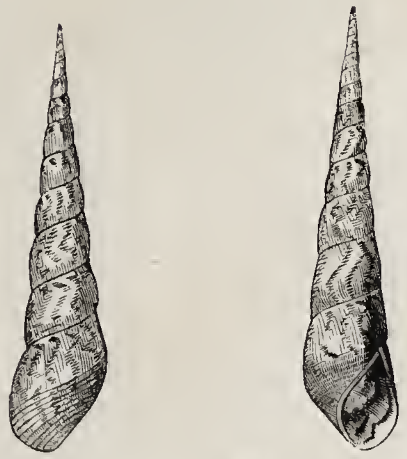


2701.—Doubtful Ampullaria.

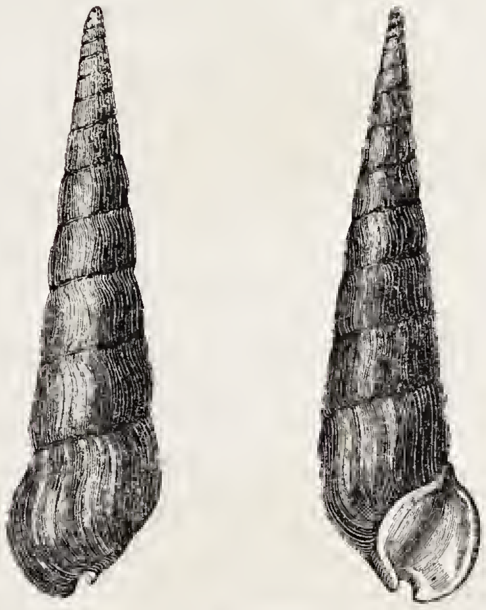


2706.—Bitter Melania.

2705.—Eared Melania.



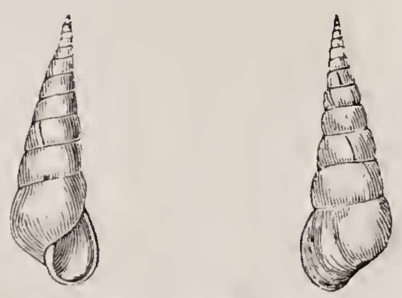
2707.—Awl-shaped Melania.



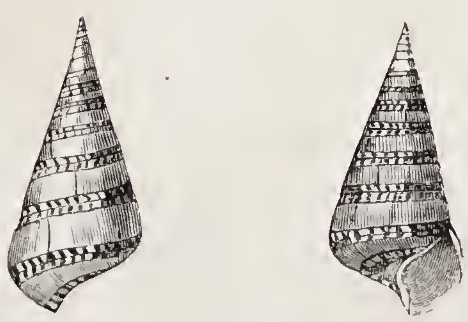
2710.—Black Melanopsis.

2708.—Eroded Melanopsis.

2709.—Ribbed Melanopsis.



2712.—Greater Eulima.



2711.—Splendid Eulima.

tula and sigaretina are noted from the blue clay of Bracklesham and the arenaceous limestone or sandstone of Bognor. The form also occurs with a ? in the list from the chalk marl, and Ampullaria canalicuta is recorded in the same paper as occurring in the gault, or Folkstone marl.

We may here notice the genus Ampullacera of Quoy (Thallicera, Swainson), of which two species are known, viz. Ampullacera Avellana, Quoy (Ampullaria avellana, Lamarck), and Ampullacera fragilis (Ampullaria fragilis, Lamarck).

Of this genus nothing was accurately known till M. Quoy had opportunities of examining the living mollusk. Chemnitz regarded the form as belonging to Nerita, and it is on his Nerita Nux avellana that Lamarck founded his Ampullaria avellana, removing the species from the situation assigned it by Chemnitz to the latter genus—and when we consider that Lamarck only knew it as a fluviatile shell from New Zealand, it must be admitted that he could not have placed it in a better position.

To the surprise, however, of M. Quoy, when he came to examine these two species alive, he found that they presented none of the characters of the Ampullariæ, and upon instituting anatomical investigations he perceived that they were organized on a particular type; in fact, that they constitute the representatives of a distinct family.

Without entering into minute details, it may suffice to say that the mollusks are bi-sexual, and formed for breathing air, though their habits are aquatic.

M. Deshayes, who adopts this genus, which he thinks one of the most interesting that has for a long time been discovered, says, "It offers in fact an entirely novel combination of an aquatic animal mollusk pulmonated and operculated, and fills up an hiatus in the system. It is with reference to the aquatic Pulmonata what the Helicinæ are with reference to the terrestrial Pulmonata; and hence Ampullacera will constitute in the system not only a genus, but a family, which ought to be placed at the end of the aquatic Pulmonata without an operculum."

M. Quoy describes the shell as thick, globular, ventricose, and deeply umbilicated; the aperture is round or oblique. "The animal is apathetic and comes but little out of its shell, into which it retires very far upon the slightest touch. We found it sunk in the muddy sand some inches under brackish water, with its aperture full of earth. It is found in great abundance in New Zealand, where it is largely eaten by the natives."

Between the genera Helicina (Ampullaria) and Rissoa, Cuvier places the genus Melania; and immediately after Rissoa, which differs very triflingly from Melania, the genus Melanopsis. Lamarck includes them in a family to which he gives the title of Melanians: by M. de Blainville they are placed in a family to which he gives the name of Ellipsostomata.

Melania is a genus of fluviatile gastropodous mollusks, inhabiting the rivers of the warmer countries generally, and of Asia especially. Species exist in Africa, and in North and South America, and Mr. Conrad has described several new species from Alabama.

The shell may be characterized as spiral, often elongated, or turriculated, with an oval aperture widened anteriorly, the edge of which is acute. There is an epidermic covering.

The mollusk is furnished with a short foot; the head is proboscidiform, conical, and truncated, the mouth being in the form of a slit, which is small and longitudinal. The tentacles, a single pair, are slender and filiform, carrying the eyes on the outer side, sometimes near the base, sometimes much higher up. The mantle is open, with festooned edges. The operculum is horny, elongated, and narrow.

It is remarkable that many of the species at least have the apex of the shell eroded, as they advance in age.

2705.—THE EARED MELANIA

(*Melania aurita*). This species is an example of the turriculated form assumed by the shells of some of this group. The mollusk is represented as crawling along, the letters *a*, *a* indicating the operculum.

2706.—THE BITTER MELANIA

(*Melania amarula*). The shell in this species is also turriculated, and the general form somewhat oval.

According to Lamarck the Melania amarula inhabits the rivers of the East Indies, Madagascar, and the Isle of France. The flesh of the mollusk is in considerable repute as a remedial agent in cases of dropsy: it is extremely bitter.

2707.—THE AWL-SHAPED MELANIA

(*Melania subulata*). The shell in this species is elongated, smoothly whorled, and pointed; the aperture is bordered.

To these examples many others might be added: M. Deshayes enumerates thirty-four living species; besides twenty-five fossil species found in various tertiary strata. Fossil Melaniæ, according to the statements of geologists, occur in the blue clay of Bracklesham, in the coralline oolite, in the Bath oolite, the Oxford oolite, the inferior oolite, and the cornbrash of our island.

The genus Melanopsis, from which Lamarck's genus Pirena cannot be separated on solid grounds, is evidently allied to Melania. With respect to Pirena, as founded by Lamarck, it contained species not only belonging to the genus Melanopsis, but also to Melania, and these being restored to their respective stations, Pirena, thus dismembered, stands as a name to be expunged from the system.

In Melanopsis the shell is covered with an epidermis; it is elongated, fusiform, or conical in shape, with a pointed apex; the whorls of the spire vary from six to sixteen in number, of which the last, viz., that in which the mouth opens, often forms two-thirds of the shell. The mouth or aperture of the shell is oval and oblong: the columella is solid, twisted, and separated at the base, by a sinus, from the outer margin of the aperture; there is often also a sinus at the posterior part of the aperture.

The mollusk has the muzzle proboscidiform, with two contractile conical tentacles, having at their base externally, each, a peduncle supporting the eyes. The foot, attached to the neck, is short, oval, and angular on each side anteriorly. Operculum horny, subspiral.

The Melanopsides inhabit the fresh waters of the south of Europe, particularly those in the neighbourhood of the Mediterranean, and the lakes and rivers of the warmer latitudes of the globe. We select three species as examples; one European, one from Syria, the other found in Madagascar.

2708.—THE ERODED MELANOPSIS

(*Melanopsis prærosa*). Melanopsis lævigata, Lam.; Melania buccinoidea, Oliv.; Melanopsis buccinoidea, Féruss.

In this form there is a single sinus at the external border of the aperture of the shell, separating it from the columella.

2709.—THE RIBBED MELANOPSIS

(*Melanopsis costata*). In this species, from the Orontes in Syria, the whorls are subturriculated.

2710.—THE BLACK MELANOPSIS

(*Melanopsis astra*). Pirena terebralis, Lam.; Strombus ater, Linn.

In this species, from Madagascar, there are two distinct sinuses or notches at the external border of the aperture, one separating the border from the columella, the other occurring at its union with the penultimate whorl.

Fossil shells of the present genus occur abundantly in many of the tertiary beds of Europe, and several species are analogous to those now living in much warmer regions. With these are found shells, which some have supposed to be of marine origin; and Mr. G. B. Sowerby, in reference to this circumstance, remarks, "We are not aware that any of the Melanopsides are marine, for all the recent species occur either in rivers or lakes, and yet most of the fossil species are found in beds that are considered by geologists to be of marine formation. We know not what degree of credit is to be given to the assertion of a celebrated author, 'that the greater number of the genera of the Pectinibranchia might formerly have contained species peculiar to rivers and lakes as well as the sea,' but this we do know, that wherever the fossil Melanopsides are found, they are accompanied by many other species of genera that at present only live in fresh water, and therefore we think they ought to be considered characteristic of the formation in which they occur."

M. Deshayes, in the last edition of Lamarck, adds the genus Eulima to the group of Melanians; and Mr. G. B. Sowerby, who in the 'Proceeds. Zool. Soc.' 1834, p. 6, et seq., describes sixteen new species, observes that "this genus of marine shells appears to be most nearly related to Pyramidella and Rissoa;" he adds, "a species which has been long known has had the appellation of Turbo politus among British Linnæan writers, and a fossil species has been placed by Lamarck among the Bulini under the specific name of Bul. terebellatus. There are two distinctly marked divisions of the genus, which are characterized by the two species above mentioned; one has a solid columella, and the other is deeply imbricated. All the species are remarkable for a brilliant polish externally, and the shells are frequently slightly and somewhat irregularly twisted in consequence of the very obsolete varices, following each other in an irregular line, principally on one side, from the apex towards the aperture. Several recent species are British, and the fossil species are found in the calcaire grossier near Paris."

The shell in this genus is described as turrited, acuminated, polished, and with many whorls; the aperture is ovate and acuminated posteriorly; the external lip is thickened, generally forming numerous obsolete varices; the operculum is thin and horny.

The Eulimæ are widely spread, occurring principally in the warmer seas; along the coasts of South and Central America, Australia, and in the Pacific Ocean.

Numerous species obtained by Mr. Cuming were dredged up at depths, not including the reefs, ranging from six to sixteen fathoms; and were found on beds of sandy mud, coarse sand, coral sand, also on reefs, and adhering to mother-of-pearl shells.

2711.—THE SPLENDID EULIMA

(*Eulima splendidula*, Sowerb. in 'Proc. Zool. Soc.' 1834).

This elegant shell was dredged in sandy mud, at a depth of from six to eight fathoms, near Saint Elena, South America. A single specimen only was obtained.

The shell is pyramidally acuminate, of a brownish colour, articulated with white and chestnut near the sutures, giving it a very agreeable appearance. It is deeply umbilicated.

2712.—THE GREATER EULIMA

(*Eulima major*, Sowerb.). This shell belongs to the non-umbilicated section; in form it is acutely pyramidal, with the external lip subarcuated. It is of a milk-white colour and opaque.

This species occurs at Tahiti, and the largest specimen obtained by Mr. Cuming was found in coral sand on the reefs.

With respect to the genus Pyramidella, it has the shell spiral and turrited; with a wide crescentic aperture, and with the base of the columella turned obliquely outwards and marked with acute spiral folds. Cuvier gives the Trochus dolabratus of Linnæus, and the Bulimus terebellum of Bruguières as examples.

M. Deshayes enumerates eleven living and eight fossil species, the latter found in the tertiary strata. The living forms inhabit the seas of warm climates, both in the old and new world. The mollusk does not appear to have been examined.

We now pass to the genus Litiopa, which M. Rang places between Phasianella and Janthina; it appears however to be destitute of an operculum, a material point of difference between this form and Phasianella. The shell is rather delicate, horny, slightly transparent, with a very thin epidermis: its figure generally is conoid; the whorls of the spire are rather rounded; the apex is acute and furrowed longitudinally, the last whorl very large comparatively; the aperture is oval, most dilated anteriorly; the left lip and base of the columella form a rounded arched projection, somewhat truncated anteriorly.

The mollusk is transparent with a rather short and narrow foot; the head is provided with two elongated conical tentacles, with the eyes at their external base. No operculum.

M. Rang describes two species, both natives of the ocean.

The shell of Litiopa is represented magnified in two views, at Fig. 2713.

With respect to the habits of this little mollusk, they much resemble those of the minute freshwater shell Physa, which we have already detailed. It lives upon floating marine plants, and moors itself to them, fixed by a long thread of glutinous matter: and thus secure suspends itself in the water. This fact was first observed by M. Bellanger, captain in the French navy, who gave some specimens preserved in spirits of wine to M. Rang, for the purpose of dissection. This naturalist states that he looked in vain for the operculum, but found attached apparently to the foot some small glairy masses, which were easily drawn out to a considerable length; the inference is, that it is by means of this glairy material that the animal is enabled to suspend itself.

We now come to a very interesting genus, viz., Janthina, or Ianthina, which Cuvier places between Pyramidella and Nerita, and which M. Lamarck arranges next to Natica.

In this genus the shell is ventricose, globular, or conoid, very fragile, with a low spire; the last whorl is by far the largest. The aperture is large and subtriangular; the columella straight and long, forming the whole of the left border or lip. The colour of all the species hitherto discovered is a violet purple more or less intense.

The mollusk has a large head, with a proboscidiform muzzle, at the end of which is the mouth, furnished with two vertical subcartilaginous lips, armed with sharp and very strong cartilaginous points curved inwards; there is also a sort of tongue.

The tentacles are two, conical, pointed, not very contractile, and separated at their base: the eyes are each on a peduncle at the root of the tentacles. The foot is oval and divided into two parts, viz. a concave anterior part, resembling a cupping-glass; and a posterior, which is flattened, thick, and fleshy.

The operculum, if it can be so called, is modified into a vesicular appendage, acting as a float, by means of which the animal suspends itself at the surface of the water. This float adheres to the posterior fleshy part of the foot.

Several species, as Janthina fragilis, J. globosa, and J. exigua, are known.

The Janthina is extensively spread, and is abundant in warm latitudes of the ocean; where it may be seen floating along. It is often driven on the shores of the more southern parts of Europe, and has occasionally on those of our own islands; but it does not appear to extend its range into very cold latitudes.

2714, 2715.—THE FRAGILE JANTHINA, OR OCEANIC SNAIL

(*Janthina fragilis*). Helix Janthina, Linnæus.—The singular float of this mollusk, which Cuvier does not consider as an operculum, he describes as a swimming organ, resembling a frothy mass (semblable à une bulle d'écume); being in fact an assemblage of air-cells, or vesicles filled with some gaseous matter, between which and the mollusk there is no organic connection. The appearance of the animal and its float of air-cells is very interesting, and we are not surprised that the latter has attracted considerable attention.

In the fourth volume of the Journal of the Philadelphia Academy is an interesting paper entitled 'Remarks on the floating apparatus and other peculiarities of the genus Janthina,' by Reynell Coates, M.D., in which he details his personal observations during a voyage to the East Indies. His experiments confirm the correctness of Cuvier as to the absence of any anatomical union between the mollusk and the air-cells of its float. He informs us that he placed some Janthinæ in a tumbler of brine, and having removed a portion of the float of one with scissors, the animal soon set to work to supply the deficiency after the following manner:—The foot was advanced upon the remaining vesicles, until about two-thirds of that part rose above the surface of the water; it was then expanded to the uttermost, and thrown back upon the water, like the foot of a Lymnæa when it begins to swim; it was then contracted at the edges, and formed into the shape of a hood, enclosing a globule of air, which was slowly applied to the extremity of the float. There was now a vibratory movement throughout the foot, and when it was again thrown back to renew the process, the globule was found enclosed in its newly-made envelope. From this it results that the membrane enclosing the cells is secreted by the foot, and that there is no attachment between the float and the animal, other than that arising from the nice adaptation and adjustment of proximate surfaces. Dr. Coates states that the float varies in different species. In Janthina fragilis he describes it as convex, subcarinate above and concave beneath, straight, and composed of large vesicles: in J. globosa he found the vesicles smaller, and the float flat both above and beneath; added to which it is formed by the reunion of one of the edges into a spiral and nearly circular disc. In J. exigua it was straight, narrow, and flattened, and the vesicles were small. Along the under surface of the float a little line of pearly fibres was remarked, to which are attached the eggs of the animal.

We may here remark, in reference to the eggs of Janthina, that Sir E. Home published in the 'Phil. Trans.' for 1817 a paper which is appended to Captain Tuckey's 'Narrative of the Expedition sent to explore the River Zaire, usually called the Congo,' in which paper he describes and figures, with the eggs of other mollusks, what he regarded as a camerated or chambered nidus for the eggs of the Janthina in its own shell. "This animal (he observes), not living at the bottom of the sea like the Vermes testacea (shelled mollusks), in general deposits its eggs on its own shell, if nothing else comes in its way. One of the specimens of the shell of the Janthina caught in the voyage to the Congo fortunately has the eggs so deposited."

This view is not corroborated by Dr. Coates or by other observers. Dr. Coates indeed states that though he had no opportunity of observing the eggs of Janthina fragilis, he is strongly inclined to believe that the eggs figured and described in the 'Phil. Trans.,' as above alluded to, belong to some other marine animal: and he grounds his belief on the dissimilarity between those figures and the eggs of J. globosa and J. exigua. In these two species the eggs are contained in little membranous bags of some consistence, which are attached in rows to the pearly fibres of the under surface of the float by small filamentous pedicles similar in appearance to the fibres. These bags are covered with minute, gelatinous, conical eminences, and are partially divided by incomplete septa, as may be seen by the aid of a powerful lens. In J. exigua, the division is very partial; but in J. globosa it gives to the whole sac a chambered appearance. It would seem that the animal consumed considerable time in depositing its eggs, for the bags nearest to the extremity of the float were constantly found empty, while the central bags contained young shells fully formed: those towards the animal were filled with eggs. The probability is, that the young animals when hatched ascend the float of the mother, and thus gaining access to the surface, construct the elements of their future support.

M. Rang, who also notices Sir Everard Home's statement, mentions it as certain that Janthina deposits its eggs sometimes in considerable number, as he has had occasion to remark, under the float, where they are attached by means of small pedicles; and he goes on to say, that the animal abandons them, together with the float, which is then charged with their preservation. M. Rang adds, that it is possible that, at this epoch, the natatory appendages of the mantle, being sufficiently developed, permit the animal to use them for swimming, and thus supply the loss; or one must suppose that these animals have the faculty of replacing the float. That they have that faculty we have above seen.

Browne, in his 'Natural History of Jamaica,' gives by no means a bad account of the floats of these animals, many of which he encountered between the Bermudas and the Western Islands, in his voyage from Jamaica. He says, "I have observed many of the vesiculæ themselves swimming upon the surface of the water, which induced me to think that they were thrown off as the creatures retired." Sloane also saw these oceanic snails, and figures them.

In January, 1833, Dr. Grant exhibited to a meeting of the Zoological Society of London numerous specimens of Janthina vulgaris, Lam., and of Velella limbosa, Lam. (one of the Acalephæ), both animals of rare occurrence on the English coast, and chiefly met with floating in tropical or warmer seas. They were obtained by him at the beginning of September, 1832, in Whitsand Bay, close to the point of the Land's End, Cornwall, where they were thrown in great numbers on the sands, after a storm of three days' continuance from the north-west: they must, he observed, consequently have been floating before they were directed to the coast by the storm, in latitudes at least as high as that in which they were found. Dr. Grant regards it as probable that neither of these animals is capable of discharging at will the gaseous fluid by which they are supported on the surface of the sea; otherwise, in such a violent and continued tempest as that which stranded them, they would have emptied their vesicles and have sunk to the stiller bottom. ('Proceeds. Zool. Soc.' January 22, 1833, p. 14.)

Browne, on the other hand, says, speaking of the float, "This raises and sustains it while it pleases to continue on the surface: but when it wants to return, it throws off its bladder and sinks."

In the 'Proceeds. Zool. Soc.' for 1835, p. 82, is a notice by Mr. Thompson of Belfast, of the occurrence of Janthina exigua on the Irish coast. His words are, "The oceanic shell, Janthina exigua, Sow., which was, I believe, for the first time noticed in 1834 as occurring on the English coast (Turton in 'Mag. of Nat. Hist.,' vol. vii. p. 352), and never before on that of Ireland, was obtained in considerable abundance in September, 1834, at Kilkee on the coast of Clare, by Mrs. James Fisher of Limerick."

Dr. Grant, in the communication referred to, suggests that the Janthina may be a predacious gastropod, and prey upon the beautiful blue velella, thus acquiring from its food the tinge of its shell; Lamarck, on the contrary, considers it as a plant-eater. It is not improbable that it be both carnivorous and herbivorous. When touched the Janthina exudes a purple liquor.

Referring to Fig. 2715, representing the animal swimming with the float expanded, the letters designate the following parts: *a*, the head; *b*, the mouth; *c*, the tentacles; *d*, the eyes; *e*, the border of the mantle at the entrance of the branchial cavity; *f*, the posterior part of the foot; *g*, the lateral expansion of the mantle provided for swimming; *h*, the anterior part of the foot; *i*, the bundle of aerated vesicles, serving to suspend the animal on the water: *m*, the eggs clustered under the vesicular bunch; *n*, the shell.

2716.—THE STRIATED LEPTOCONCHUS

(*Leptoconchus striatus*). This delicate shell was first described by Dr. Rüppell in the 'Proceeds. Zool. Soc.' 1834, p. 105, and subsequently more fully in the 'Transactions' of the same Society, vol. i.

The shell is pellucid, subglobose, with a depressed and almost obsolete spire, with a large suboval aperture. In general form the mollusk approaches Janthina, and is destitute of an operculum; and Dr. Rüppell "suggests that the systematic place which should be assigned to this genus is near the Janthinæ. The number of the tentacula, the oval proboscis, the mantle destitute of siphon, the pectinated branchiæ composed of closely heaped pyramids, are so many marks of affinity; to which may be added some of the characters of the shell. But he states himself to be perfectly aware of the difference between the habitations of these genera, which is so wide as to afford no confirmation of the correctness of this approximation." ('Proceeds. Zool. Soc.')

The shell is of a dirty milk-white, furrowed externally with numerous longitudinal undulated lines. The Leptoconchus striatus is found in the Red Sea, imbedded in calcareous masses of coral, generally Meandrina, and has no communication with the water, excepting by a moderate opening; in the same coral mass are also imbedded Magilus, Venerupes, and other shells.

2717.—THE STAR-FISH STYLIFER

(*Stylifer astericola*, Brod.). The little parasitic shells to which Mr. Broderip has assigned the generic appellation of Stylifer, from the little style at their apex, he regards as constituting the type of a distinct family.

Mr. Broderip's observations on Stylifer (or Stilifer) will be found in the 'Proceeds. Zool. Soc.' March 27, 1832, p. 60, where the characters of the genus are laid down. He characterizes the shell as hyaline, turbinate, with the apex of the spire assuming the form of a style; with the aperture subovate and acuminated above. The lip is acute and sinuate or waved.

The mollusk has its mantle thick, fleshy, cup-shaped, and covering the last whorls of the shell. The proboscis is very long and retractile. The tentacula are round, thick, subacuminate, and placed at the base of the proboscis. The eyes at the base of the tentacles are sessile, and very minute. The branchial apparatus appears in the form of a single filament. After a more minute account of the anatomy of the mollusk, Mr. Broderip, in reference to the present species, adds: "Mr. Cuming found this elegant parasite burrowed in different parts of the rays of the oral disc of Asterias solaris. It was almost hidden from sight, so deeply does the animal penetrate into the substance of the star-fish, in which it makes a comfortable cyst for itself, and wherein it most probably turns by the aid of its rudimentary foot. All the specimens infested with these testaceous mollusks appeared to be in the best health, though there is reason to believe that they feed upon the juices of the star-fish. Mr. Broderip observes that Stylifer (with that instinct of self-preservation which is imparted to all parasites whose existence depends upon that of their nidus) appears, like the larvæ of the ichneumon tribes among insects, to avoid the vital parts; for in no instance did Mr. Cuming find it imbedded anywhere save in the rays, though some of the individuals had penetrated at their base, and very near the disc. When extracted, the older shells have the appearance of a milky-clouded glass bubble: the younger shells Mr. Broderip found of an unclouded transparency.

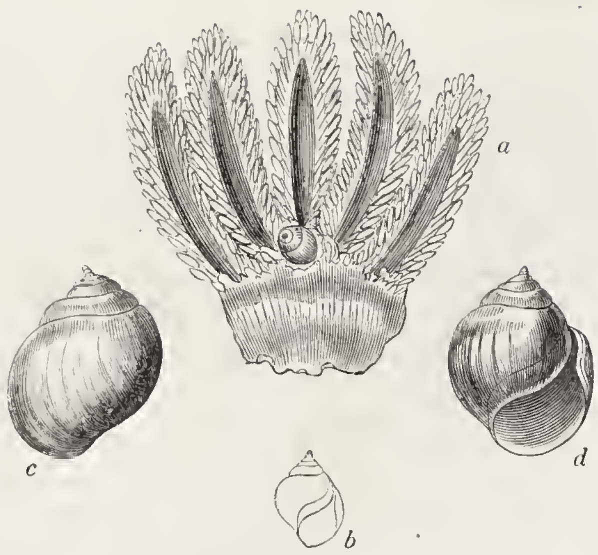
Referring to Fig. 2717, *a* represents a portion of the Sea-star, Asterias solaris, showing Stylifer astericola in its cyst; *b*, a fine specimen of the shell; *c* and *d*, upper and under views of the same, magnified.

2718.—TURTON'S STYLIFER

(*Stylifer Turtoni*, Brod.). In the 'Proceedings' already referred to, Mr. Broderip, in reference to the present species, remarks, that Dr. Turton, in the second volume of the 'Zoological Journal,' p. 367, pl. 13, describes and figures a shell under the name of Phasianella stylifera, adding that he found a dozen attached to the species of Echinus esculentus dredged up in Torbay. Mr. Broderip observes that it is clear that Dr. Turton's shell is not a Phasianella, for it is described as having no operculum, and the similarity of the shell leaves no doubt, when joined to the parasitic habits of the animals, that it is one of the congeners of Stylifer astericola. Mr. Broderip therefore names Dr. Turton's specimen Stylifer Turtoni. It is represented of the natural size and magnified.

2719.—THE AWL-SHAPED STYLIFER

(*Stylifer subulatus*, Brod.). A third species of this genus is termed subulatus from its elongated figure. It is a native of the West Indian Seas. Mr. Broderip observes that the shell is so beautifully transparent that the columella in fine specimens can be seen as distinctly as if there were no intervening medium. The long apex, which consists of many close-set whorls, is generally out of the perpendicular. The habits of this species are unknown.

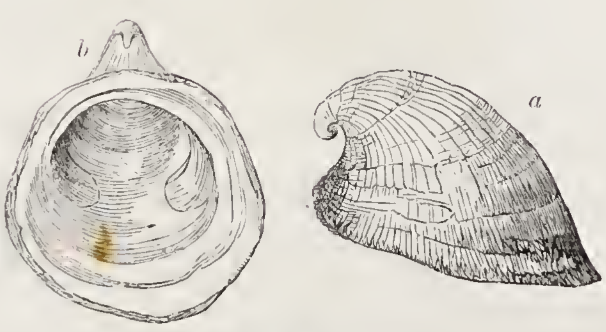


2717.—Starfish Stylifer.

2713.—Litiopa, magnified.

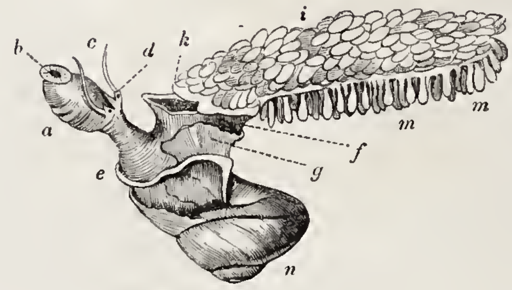
2720.—Acute Hipponyx.

2718.—Turton's Stylifer.

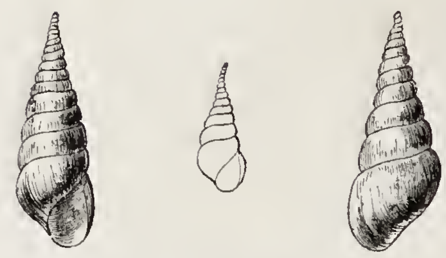


2722.—Common Pileopsis.

2714.—Fragile Janthina.



2715.—Oceanic Snail, swimming.

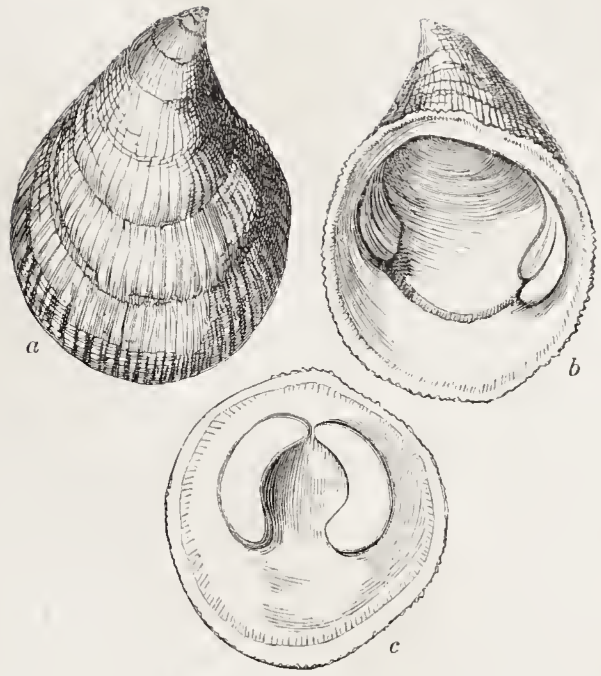


2719.—Awl-shaped Stylifer.

2721.—Acute Hipponyx.

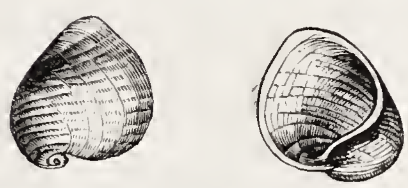
2716.—Striated Leptoconchus.

2727.—Leach's Cryptosome.

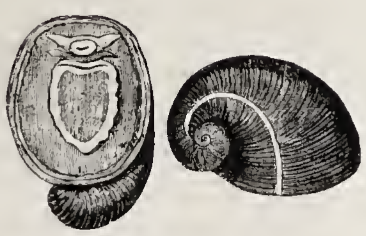


2723.—Hipponyx cornucopia : fossil.

2725.—Convex Sigaretus



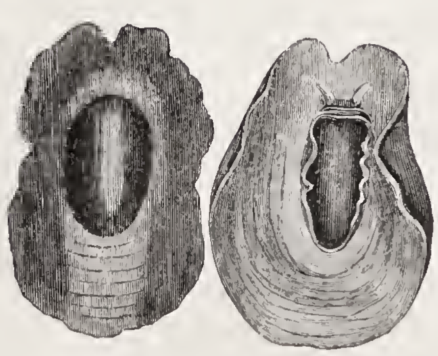
2729.—Velutina lævigata.



2728.—Velutina capuloidea.

2726.—Sigaretus haliotoideus.

2730.—Ordinary Cone.



2724.—Black Coriocella.

The shell is represented of the natural size and magnified.

Family CAPULIDÆ (HIPPONYX PILEOPSIS, SIGARETUS, &c.).

In this family, *Les Capuloides*, says Cuvier, are placed certain genera of which four have been removed from the Patellæ. They have all, he says, a shell with a patulous opening, and but slightly turbinated; without operculum, notch, or a siphon. In other points they resemble the other Pectinibranchiata.

With respect to the genus Hipponyx, which we may here state is one of the forms in the present family the shell of which is patelloid, Mr. Sowerby was inclined to refer it to the acephalous or bivalve mollusks, because among other reasons its shell was found to consist of two parts; in which view he differed from Defrance, who regarded it as a univalve with the property of making a support for the purpose of raising itself above the shells or stones to which it is attached. Lamarck considered Hipponyx a subgenus of Pileopsis (Capulus, Montf.).

M. Deshayes, in the last edition of the 'Animaux sans Vertèbres,' observes that the short description given by Cuvier, in the 'Annales du Museum,' of Pileopsis, is the only one known at present; and this description teaches us that the animal, attached to its shell by a muscle in the shape of a horse-shoe, is provided with a foot comparable with that of the Patellæ; that it has a rather large cervical cavity containing a pectinated branchia comparable with that of the Crepidulæ; and finally, that it has a proboscidiform head, with two tentacles with eyes at their base. Observation has long demonstrated that the true Pileopsides, though they live after the manner of the Patellæ, are still more sedentary than the latter; for there may be seen, in certain individuals of the Pileopsis Ungarica, irregularities proceeding from the body on which it has lived when young continuing exactly the same to adult age—irregularities whose traces may be observed on the lines of growth, and which prove, in the opinion of M. Deshayes, that during its whole life the animal has never changed its place. This mode of existence approaches closely to that of Hipponyx. The latter genus, established by Defrance, was considered by Lamarck to be merely a section of the Pileopsides. Other zoologists, M. de Blainville among them, resting on new facts, adopted the genus of Defrance, and placed it in the neighbourhood of Pileopsis. M. Deshayes, however, thinks that it will nevertheless be possible, after a close examination of the two genera, to return to the opinion of Lamarck, and thus supports it.

The Hipponyces have a shell resembling that of the Pileopsides, but their delicate foot assumes the properties of the mantle, and becomes a secreting organ, producing a more or less thick calcareous support, on which the animal is attached by the same horseshoe-shaped muscle which is inserted in the shell. The animal of Hipponyx then remains necessarily attached, after the manner of the Oysters and Craniæ, to submarine bodies. This manner of life in a cephalous or headed mollusk, and the property which it possesses of secreting a support, gives it a resemblance to a bivalve shell without a hinge. This support, which is very thick in some species, diminishes insensibly in others, and sometimes becomes very delicate. M. Deshayes states his knowledge of certain species which, instead of secreting a support, attach themselves to other shells, and thereon hollow out to some depth the place on which they live. This impression offers exactly the same form and the same accidents as the more or less thick support above noticed. Between these species and those which live sedentary, without leaving any trace on the body which has served them for a resting-place, there exists but very little difference; and it is to be presumed that there is no considerable discrepancy in the organization of the animals. Thus, in his opinion, the passage between Pileopsis and Hipponyx is established, and the opinion of Lamarck justified.

M. de Blainville, MM. Quoy and Gaimard, and others have confirmed these details in every important respect. It would appear that the animals are diœcious.

2720, 2721.—THE ACUTE HIPPONYX

(*Hipponyx acuta*). Capulus acutus. In the genus Hipponyx the shell is conoid or depressed; the apex not spiral; the aperture with irregular edges; the cavity deep with a horse-shoe muscular impression. The foot secretes a lamellar support, presenting a similar muscular impression.

The animals of this genus are marine and are found attached to stones and shells at various depths from the surface to sixteen fathoms.

The Hipponyx acuta is a native of the seas of New Holland; its limpet-like shell is striated longitudinally, and has the edge crenulate; the colour externally is purplish, internally white.

Besides the present species, Deshayes enumerates five others, to which should be added Patella Australis and Patella mitrata.

Referring to Fig. 2720, *a* shows the upper valve in its natural position; *b*, an inside view of the same. At Fig. 2721 we have a variety of H. acuta; *a* shows the animal; *b*, the shell.

2722.—THE COMMON PILEOPSIS

(*Pileopsis ungarica*). In the genus Pileopsis the shell is irregular and conical, with the apex more or less spiral, and directed backwards: the aperture is rounded, simple, and irregular; the cavity is deep with a horse-shoe muscular impression. The mollusk does not secrete any shelly lamellar support. The genus Pileopsis consists entirely of marine species, which are found adhering to stones at various depths from the surface to twenty fathoms. Like the limpets, they do not appear to remove from the spot to which they are first attached, and they form, probably by the chemical agency of some solvent fluid, or, as some suppose, by the long continued operation of currents of water, a cavity more or less deep in the surface to which they adhere. The seas of the East and West Indies, and of Europe, produce their respective species.

The Pileopsis ungarica is common in the Mediterranean and on the coasts of our island and the adjacent continent. The shell is striated, the vertex revolute; it is covered with a thick and somewhat velvety epidermis; the interior is roseate. At Fig. 2722, *a* represents the shell in situ; *b*, an inside view.

M. Deshayes records eleven species, to which should be added Paella Galathea and P. tricostata.

Fossil specimens both of Hipponyx and Pileopsis occur, principally in the mountain limestone, and also in tertiary strata; P. ungarica is met with in a fossil state in beds belonging to the latter system. At Fig. 2723 is represented a fossil species of Hipponyx, viz., H. cornucopia (Patella cornucopia of Lamarck): *a* represents an external view of the upper valve; *b*, an internal view of the same; *c*, the inside of the lower valve, or lamellar support.

2724.—THE BLACK CORIOCELLA

(*Coriocella nigra*). In the genus Coriocella, the mollusk, though it has the back covered with a delicate flexible shell, may be regarded as naked; M. de Blainville, indeed, says that it is utterly shell-less, but he is here in error, for a shell in a rudimentary state does exist. The body of the mollusk is elliptical and much depressed: the borders of the mantle are very delicate, spreading out largely on all sides, and notched in front; the foot is oval and small; the head is indistinct; it supports two tentacula hidden under the shield formed by the mantle; they are short and contractile, with the eyes externally at their base. The back is somewhat convex.

One species only is known, viz., the Coriocella nigra, from the seas of the Isle of France, and was first described by De Blainville from a specimen in his possession. He places this genus, with Sigaretus, Velutina, and some others, in his order Chismobranchiata, the second of his subclass Paracephalophora monoica.

The animal is represented at Fig. 2724 in two aspects, one showing the upper, the other the under surface.

2725.—THE CONVEX SIGARETUS

(*Sigaretus convexus*). In the genus Sigaretus, which closely approaches the preceding, the shell is far more amply developed, and in some species it is thick and solid. It is more or less depressed, with a patulous aperture, and a little spire, the whorls of which increase very suddenly. During the life of the mollusk, it is enveloped in a spongy shield, which greatly encompasses its borders, as well as the foot, which is the true mantle. In front of this mantle there is a notch and a short canal which serve to conduct water into the branchial cavity. The tentacula are conical, and the eyes are placed at their external base. Only a few living species of this genus are known.

The Sigaretus is represented in two views, one exhibiting the under surface of the animal, to show the foot, tentacles, and canal. The other is a lateral view. The shell is smooth and very delicate.

At Fig. 2726 an allied species, Sigaretus haliotoïdeus, is represented, distinguished by a thick solid shell marked with striæ.

2727.—LEACH'S CRYPTOSOME

(*Cryptosoma Leachii*). The genus Cryptosoma, founded by M. de Blainville, is so nearly allied to Sigaretus, that Mr. G. B. Sowerby doubts the propriety of its separation, and says, respecting the specimens in the British Museum, "we are convinced that De Blainville's Cryptosoma Leachii is the same as one of the two shells which Adanson calls Sigaret."

M. de Blainville states that he knows two species, both from India: and Cuvier, who admits the genus, in his last edition of the 'Règne Animal' says, "Besides the species C. Leachii, in the British Museum, we have another, C. Carolinum, sent from Carolina by M. l'Herminier.

The shell in Cryptosoma closely resembles that of Sigaretus; it covers the head and abdomen, and is carried upon a foot four times its size, cut almost squarely behind, and which produces anteriorly a fleshy part of an oblong figure, which constitutes nearly one half of the mass. The head of the mollusk is flat, with two tentacles; the branchial apparatus is large, and pectinated and placed on the ceiling of the dorsal cavity.

2728.—THE VELUTINA

(*Velutina capuloidea*). Helix lævigata, Linn. M. de Blainville observes that he founded the genus Velutina upon an individual provided with its shell, which he owed to the generosity of M. Defrance; he adds that he is acquainted with only one species, from the coast of England, which is very probably the same as that of which Müller speaks under the name of Bulla Velutina; and which Lamarck erroneously regarded as the analogue of his Sigaretus haliotoïdeus. Mr. Gray, he adds, also proposed the genus under the same name. The latter zoologist places Velutina as the type of a family, between his Truncatellidæ and Paludinidæ.

The shell is patelliform, covered with an epidermis, with a small lateral spire, and without a columella; the aperture is large; the edges almost continuous and sharp.

The animal has the border of the mantle simple anteriorly, and double for the rest of its circumference. The foot is thick; the tentacles bare, conical, and distant, with a small frontal veil between them. The eyes are black, and seated at the external side of the base of the tentacles. The mouth is large, at the extremity of a sort of muzzle. The muscle of attachment is of a horse-shoe shape.

The shell of Velutina lævigata (Velutina capuloidea) is represented at Fig. 2729 as destitute of the mollusk.

Family CONIIDÆ (CONES).

The Cones are all included by Linnæus in one genus; Cuvier makes them a great division of his family "Les Buccinoides." M. de Blainville unites them with the Ovulæ, Cyprææ, Volutæ, and Terebella, under the family title of Angyostomata.

With respect to the genus Conus, Lamarck separated it into two divisions, the first comprising those species which have a coronated, the second containing those with a simple spire.

M. de Blainville divides the genus as follows:

α, Conical species, with a projecting spire, which is not crowned with tubercles. Example, Conus generalis (Genus Conus).

β, Conical species, with a coronated spire, which is either projecting or flattened. Example, Conus imperialis (Genus Rhombus, Montfort).

γ, Species a little elongated, suboval, the spire projecting and pointed, but not coronated or crowned with tubercles. Example, Conus textilis (Genus Cylinder, Montfort).

δ, Subcylindrical species; the spire apparent and coronated. Example, Conus geographus (Genus Rollus, Montfort).

ε, Elongated cylindrical species, with a projecting spire, and the aperture angular posteriorly, as in Terebellum. Example, Conus Nussatella, and C. Mitratus (Genus Hermes, Montfort).

When we consider the multitude of species included in the genus Conus, some such division is necessary, if only for the sake of convenience, and of assisting the student. Deshayes and Lamarck enumerate one hundred and eighty-one recent species. To these Mr. Sowerby and Mr. Broderip have added many more, so that about two hundred and ten species, or perhaps more, are recorded. We must, however, bear in mind the caution given by Mr. Broderip, in the 'Proceeds. Zool. Soc.' 1833, p. 52, who as preliminary to a description of many species brought by Mr. Cuming from the Western coast of South America, and the islands of the South Pacific Ocean, states "the difficulty of the task, arising from the infinite varieties presented by this genus; and the very few points of form and structure in the shell which can be relied on as the foundations of specific character." And he emphatically adds: "M. de Blainville, when noticing the numerous species already recorded, gives us a hint that many of them may be what Adanson calls 'espèces de cabinet,' and no one can examine an extensive collection of cones, particularly if it contain many individuals of each species, for the purpose of comparison, without being struck by the force of the observation. Colour, granulation, or smoothness, length or shortness of the spire, its plainness or coronation, will be found in many spe-

cies the result of locality, food, or temperature." M. Duclos, in reference to the numbers given by Lamarck, states, that he is convinced that there are many of the species which can only be regarded as varieties at most.

Many of these species and varieties are very beautiful, both in shape and colour, and the genus has always been highly valued by collectors. Coni gloria-maris, cedo-nulli, omaicus, aurisiacus, ammiralis, and some others, have brought very large prices, and some of the finest specimens of these shells are now in this country.

The cones are principally confined to the southern and tropical seas; and though a few species are found in the Mediterranean, none exist as far as yet known in the northern seas; in fact their numerical ratio decreases as we pass northwards from the intertropical latitudes.

In their congenial waters, these shells are found on sandy bottoms at depths varying from a few feet to seventeen fathoms.

The mollusks are carnivorous.

With respect to generic characters they may be summed up as follows:—

Shell thick, solid, rolled up, as it were, in a conical form; epidermis membranous, sometimes very thick; spire of different degrees of elevation, sometimes almost flat; aperture long and very narrow, widening a little anteriorly; lips generally straight and parallel, the outer lip simple and sharp-edged, sometimes a little curved, the inner lip without any plaits on the columella, but with a few elevated striæ on its anterior termination. Operculum horny, very small, subspiral, with a terminal summit, placed obliquely on the back part of the foot, and, when compared with the length of the aperture, appearing like a rudiment.

Animal elongated, very much compressed and involved, with a very distinct head, terminated by a proboscis capable of much extension; mouth with a tongue rather short, but projecting, and armed with two rows of sharp teeth; tentacula cylindrical, carrying the eyes near the summit; foot oval, elongated, wider before than it is behind, with a transverse anterior channel; mantle scanty, narrow, forming an elongated siphon in front.

2730.—THE ORDINARY CONE

(*Conus generalis*). This species is an example of the group, characterized by a smooth projecting spire; not coronated (that is, not crowned with tubercles). Independently of its beautiful marbling, the elegance of its form is sufficient to arrest the attention of the most superficial observer.

At Fig. 2731 is represented the animal of a distinct species of Conus, viz. Conus Brandanus:—*a*, as seen in profile; *b*, the under side; *d*, the operculum.

The genus Conus occurs in a fossil state.

Lamarck records nine fossil species. Deshayes in his tables makes the number forty-nine (tertiary), one of which, C. Mediterraneus, he gives us both living and fossil (tertiary). Mr. G. B. Sowerby ('Genera') says "Fossil cones are not unfrequent; but we believe that they occur only in the newer strata, or those above the chalk, such as the London clay and crag in England, the calcaire grossier in France, and the contemporaneous beds in other countries; there are a few seen in collections, filled with a course, dark-green arenaceous substance; these belong to the terrains calcareo-trappéens of Brongniart. Doubtful casts are met with in the inferior oolite, according to Conybeare and Phillips." The same author gives a figure of C. dormitor, a fossil from Barton, approaching very near to a Pleurotoma. Many species are found in the blue marls of the south of France. (M. Marcel de Serres.) M. de Basterot gives many from Bordeaux and Dax, &c., one of them, C. deperditus of Lamarck, as analogous to the existing species at Owhyhee. Among the fossil species from the western borders of the Red Sea, collected by Mr. James Burton, named by Mr. Gray and Mr. Frembley, and communicated to Mr. Lyell by Mr. Greenough, are twelve species all living; but neither C. Mediterraneus nor C. deperditus appears in the list.

2732.—THE LINEATED CONOELIX

(*Conoelix lineatus*). This genus Conoelix, Conœlix, or Conohelix, was established by Mr. Swainson for a group of shells which he regards as constituting a beautiful link between the true Cones and the Volutes. The shell he describes as coniform, with a very short spire; the outer lip is simple, the columella plaited. The aperture is linear and narrow. The mollusk is not known. The lineated Conoelix inhabits the South Seas. Several other species are known; some from the Pelew Islands, others from Tahiti, Raiatea, &c.

Family VOLUTIDÆ (VOLUTES, OLIVES, &c.).

The Volutidæ form an extensive group of most beautiful and interesting shells, the mollusks of which are decidedly carnivorous.

Mr. Gray (in his 'Synopsis of the Brit. Mus.' 1842) divides the Volutidæ into the following genera, viz., Cymbium, Volutella, Voluta, Mitra, Vulpecula, Turris, Volvaria, Imbricaria, Marginella, Hyalina, and Persicula.

With respect to the general characters of the family this eminent naturalist observes that the Volutes have all a recurved siphon, and only a notch in front of the mouth of the shell; but the front of the pillar of the shell is regularly and obliquely plaited. The foot of the animal is very large, partly hiding the shell, and generally deeply nicked on each side in front. Mostly the shell is covered with a distinct epidermis or periostraca; but in a few, as Cymbium (Cymba, Broder.) the animal, when any sand or other matter gets between the shell and the upper surface of the foot, secretes a quantity of shelly matter, and covers the adventitious substance with a glassy layer, so as to prevent the extraneous particles from irritating it. In some, Mr. Gray remarks (as Voluta angulata), one of the sides, and in others (as Marginella) both sides, of the mantle are produced, and reflected over the back of the shell; and the shelly matter secreted by these parts covers the outer surface of the shell with a polished coat like the cowries (Cypræa). This polished coating is also expressly noticed by Mr. Broderip who, after commenting on Lamarck's assertion that the Volutæ appear to be unprovided with an epidermis, and stating that a careful examination of a collection of these testaceans now in the British Museum has enabled him to express his belief that few if any of the species of Cymba, Melo, or Voluta are without it, goes on to say that the species of Cymba have not only this "drap marin," but also the additional protection of a glaze or vitreous pellicle, secreted by the animal, and more or less extended over the shell. This last is increased as the animal advances in age, and in some species, as Cymbæ proboscidalis, porcina, rubiginosa, &c., forms a complete surtout, which in old specimens has such an appearance as has led more than one uninitiated spectator to inquire whether a thick coating of enamel had not been poured over the shell. (Sowerby's 'Genera,' and Species Conchyliorum.)

Only a few species are provided with a horny operculum. Of one genus, Cymbium, or Cymba, the animals are ovoviviparous; the shell in the newly born young is comparatively very large, and the apex of the spire often irregularly twisted.

Mr. Swainson, who regards the Volutidæ as forming one of the most beautiful and interesting families of the gastropodous mollusks, states that in the majority the eyes are sessile, placed at the base of two short tentacula; and that the mouth is probosciform and extensile, while the foot, in the typical species, is of enormous size. He adds, that the shells present us with more tangible characters than the mollusks. "The base is never prolonged, although in some mitres (Tiara) it is contracted. In all others it is truncated and deeply notched. The plaits upon the pillar are always at the base, not in the middle of the aperture; though in some, as Oliva, &c., they assume peculiar modifications. The proportion of the spire to the aperture varies in almost every genus, and is therefore but a subordinate character. Numerous as is this family, nearly all the species are confined to warm latitudes, particularly those of the tropics. It is hardly necessary to add that the whole are predacious and consequently carnivorous."

Mr. Swainson subdivided the Family Volutidæ into the following sections or subfamilies:—

1. *Volutinæ*, or typical Volutes, having a short spire, more or less papillary, with the lower plaits upon the pillar (columellar lip) the largest; the foot excessively large and enveloping the sides of the shell.

2. *Mitrinæ*, or Mitres, having the spire always acute, generally longer than the aperture, and the lowest columellar plaits the smallest. The foot is small, not dilated at the sides; and the oral proboscis is long.

3. *Olivinæ*, or Olives, cylindrical in shape; the aperture linear; with the columellar lip thickened and confusedly plaited.

4. *Ancillarinæ*, the aperture wide, and the base of the pillar alone thickened and striated.

5. *Marginellinæ*, Date-shells, having plaits upon the pillar, and crenated teeth on the thickened outer lip: the foot very large, but the mantle neither lobed nor reflected.

With respect to Conoelix, which we have above described, it forms a genus under the subfamily Mitrinæ, in Mr. Swainson's arrangement.

From these preliminary observations on the Volutidæ, we shall now proceed to our pictorial specimens, which will convey far clearer ideas of the forms of this family than the most elaborate description.

2733.—NEPTUNE'S CYMBA

(*Cymba Neptuni*). In the genus Cymba (Cymbium, Montf.) the last whorl is ventricose. The animal has a large thick fleshy foot, without an operculum; there is a veil on the head, at the sides of which are the tentacles. The proboscis is rather long, and its siphon has an appendage on each side of its base. The shells grow to a large size, and many are very beautiful. In full-grown specimens the spire and apex are entirely concealed, being overhung by the upper border of the last or body whorl, which is carinated and somewhat reflected, so as to form an open and somewhat round concavity. The shell is of a brownish red colour, with a strong brown epidermis, over which an enamel-like glaze is extended over about a fourth part of the shell, leaving the epidermis of the back uncoated. The pillar is four-plaited.

The Cymba Neptuni is found on the coasts of Africa generally, in shallow water on sand or mud. Referring to Fig 2733, *a* shows the Cymba, with its large patulous aperture, the upper rim of which may be seen reflected and hiding the spire; it exhibits also the four plaits of the columella, and the extent to which the glaze of enamel is deposited; *b* shows the same shell seen from above; and *c*, the young shell in the same aspect; in this, it will be observed that the spire is visible, and that the upper edge of the rim has not yet acquired its perfect degree of development.

2734, 2735.—THE MELO

(*Melo Æthiopicus*). Animal and shell. The mollusk has the form of its body fitted to the concavity of the whorl in which it is lodged. It is enveloped by a mantle, of rather delicate structure, except at the borders, where it is thickened, but not to any great degree; and without any trace of cirrhi or lobes. Below the anterior part is a very considerable and thick respiratory canal; at the posterior root of which is a tentacular appendage. The foot is extremely voluminous, of an oval form, very convex above, without any trace of a transverse or a longitudinal furrow.

It is, however, capable of being withdrawn in great part into the shell, by folding longitudinally. The head forms a distinct and large mass, flattened and bordered on its circumference by a sort of veil with thick edges, and doubtless susceptible of great extension. The tentacles are lateral, very distant from each other, conical, rather elongated and contractile. The eyes, remarkable for their size, are also very distant from each other, sessile, and placed behind the tentacles. They exhibit a distinct pupil, an enormous crystalline lens, and a black choroid membrane; the skin passes delicate and transparent over them, forming a cornea. Two small slips, apparently muscular, have been detected posteriorly to these organs. Below the head issues a sort of proboscis, very thick, subcylindrical, with a small vertical aperture.

The branchial cavity, as the form of the shell indicates, is extremely extended, occupying the whole of the last whorl; it communicates with the circumambient fluid by means of a very thick muscular siphon. There are two large branchial combs; the right exceeding the left and formed by a single row of pectinations, whilst the left has a double row. (See 'Zoologie de l'Uranie.')

The shell is ovate, ventricose, of an orange-cinnamon colour. The spire is crowned with thickly-set acute spines. The pillar has four plaits or wreaths.

This species appears to be extensively spread; it is found in the African seas, according to Lamarck, and occurs also in those of India. It is stated to have been taken in Sharks Bay, Australia, and the specimen described in the 'Zoologie de l'Uranie' was, as we are informed, obtained in the latter locality.

The animal is seen in two positions at Fig. 2734, and the shell at Fig. 2735.

The species of the genus Melo are numerous; they are generally found in shallow water, on beds of sand or mud.

Both the genera Cymba and Melo belong to the Turbinelliform type of the genus Voluta, according to Mr. Swainson's arrangement; and this type or section he characterizes as follows:—Shell melon-shaped; spire very short, sometimes nearly obsolete.

The other types of the Volutinæ are—

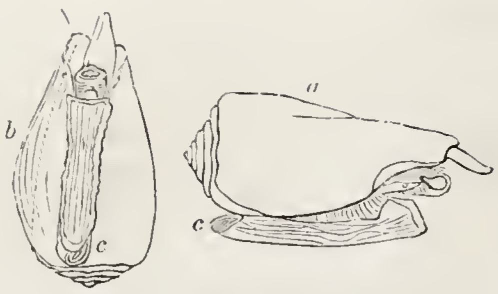
The Muriciform type, with a shell heavy, less ventricose, coronated with cylindrical or vaulted spines (Example, Voluta imperialis).

The Strombiform type, with the outer lip of the shell dilated, and angulated above (Example, Voluta Scapha).

The Ancilliform type, with the aperture of the shell wide and the spire pointed (Example, Voluta angulata).

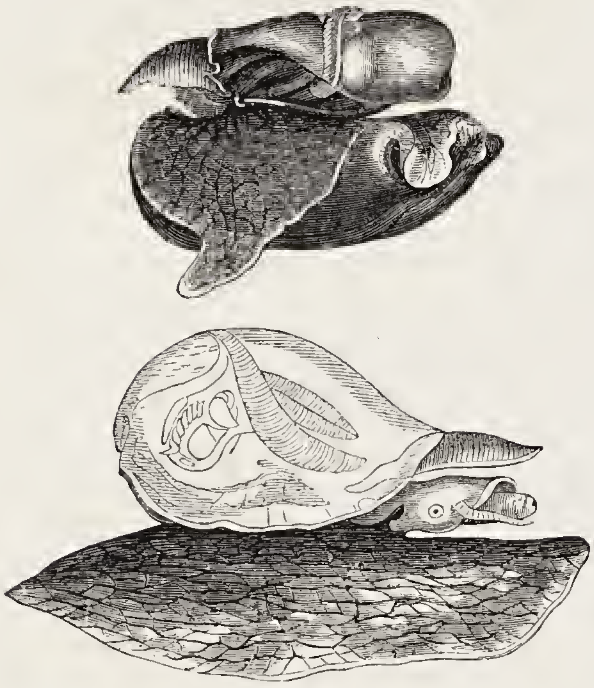
The Marginelliform type, with the shell partly polished and ventricose (Example, Voluta magnifica).

Besides the genus Voluta, including Cymba and Melo, Mr. Swainson enumerates four other genera



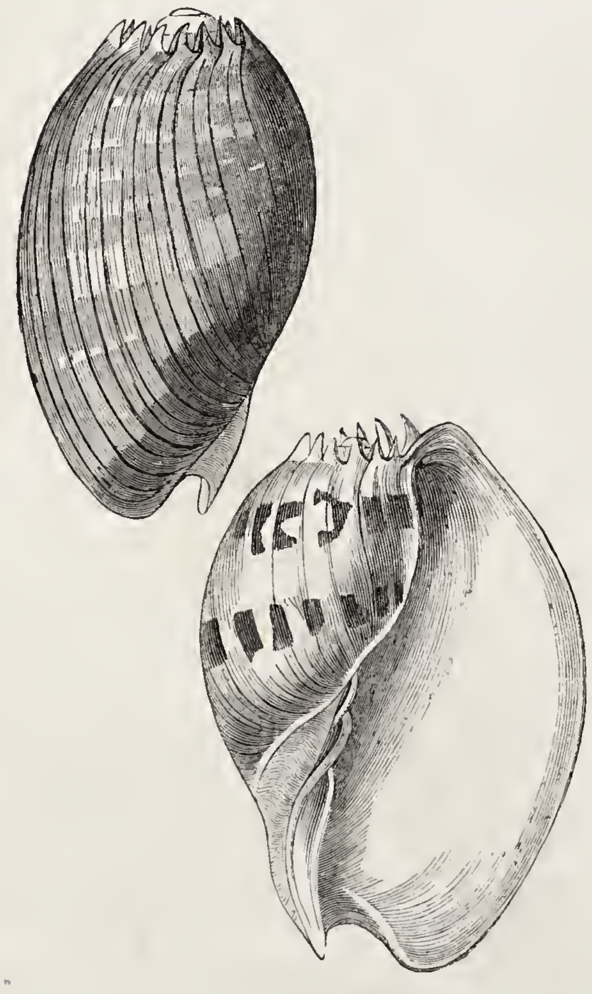
2731.—Animal of Conus Bandanus.

2732.—Lineated Conoelix.



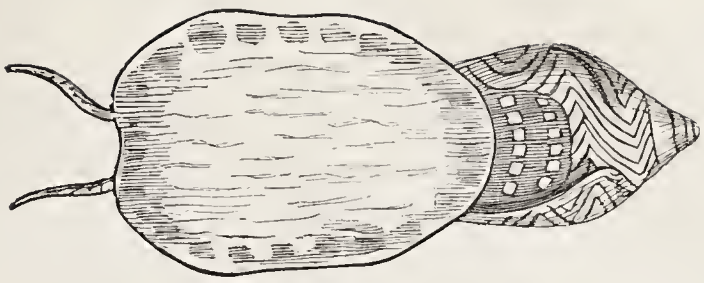
2734.—Melo: Animal.

2733.—Neptune's Cymba.

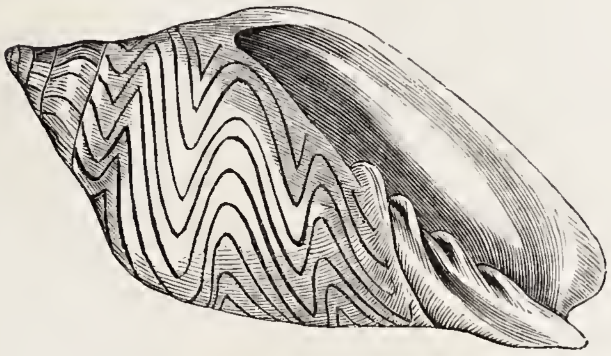


2735.—Shell of Melo.

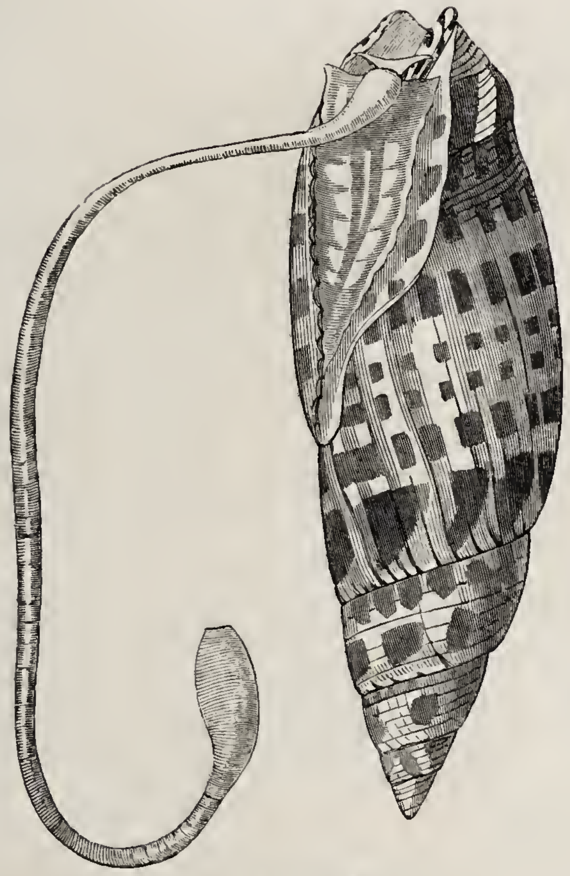
2740.—Bat Volute.



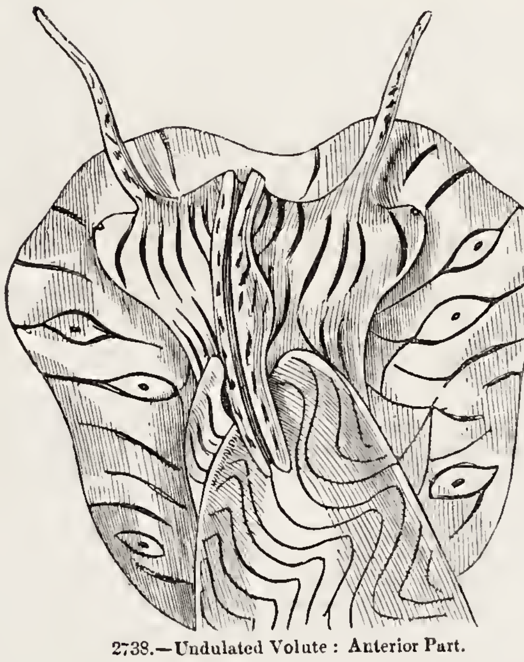
2736.—Undulated Volute : expanded Foot.



2737.—Shell of Undulated Volute.

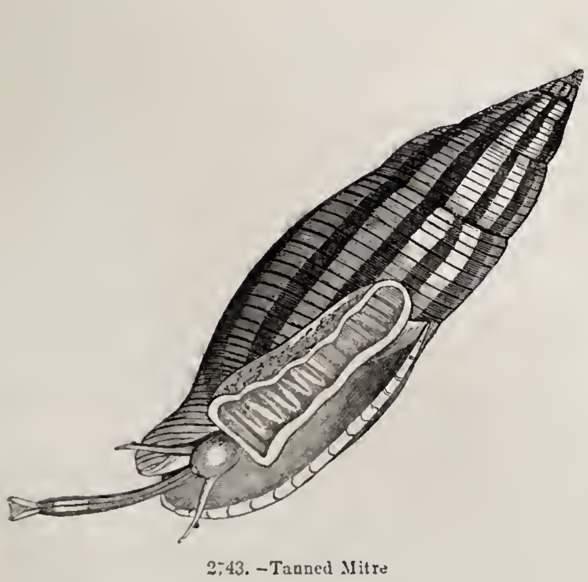


2741.—Episcopal Mitre.

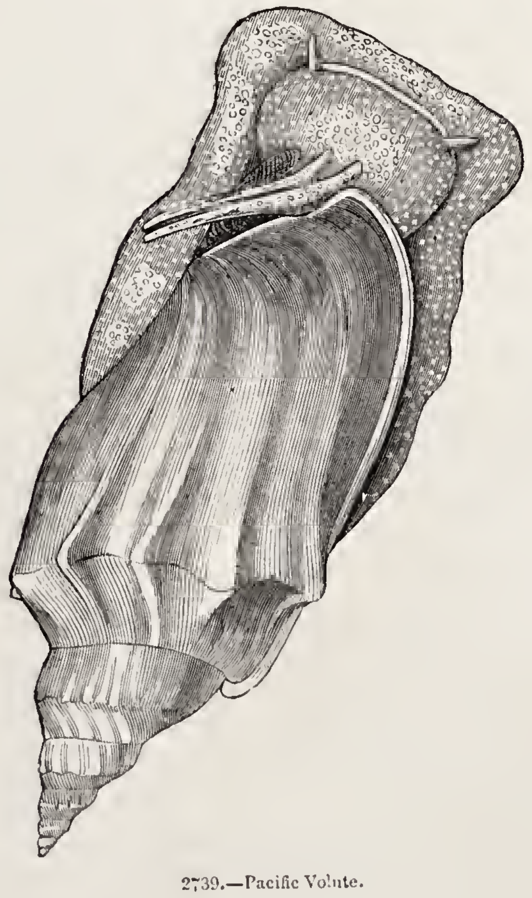


2738.—Undulated Volute : Anterior Part.

2742.—Episcopal Mitre.



2743.—Tanned Mitre



2739.—Pacific Volute.

under the group Volutinæ; fourteen genera and subgenera under the group Mitrinæ: five genera under the group Olivinæ; one genus in Ancillarinæ, and five genera in Marginellinæ.

From such a number of genera we may easily form some idea of the overwhelming multitude of species which the family Volutidæ contains: the study of such a family, without instituting sections, even on artificial grounds, would be a work of immense difficulty,—as it is, the labour is not trifling: nor do our observations apply only to the Volutidæ, they are applicable to every family of gastropodous mollusks. Nor is this labour decreased when we come to review the various systems which different writers have adopted, and the opposite views which they entertain. Hence we find genera located first in one section, then in another, or utterly dismembered by one writer, who scatters the species abroad, forms many genera from them, or assigns them to genera already established; while another writer perhaps will, more or less, completely reunite them, and place them in a new situation. Look, for instance, at the Capulidæ, or Les Capuloides of Cuvier ('Règne Animal,' p. 86), which, in that great naturalist's opinion, comprehends five genera, of which four are dismembered from the Limpets (Patellæ). Instead of five genera, however, under his Capuloides he gives the characters of ten, of which we find five including species which have been regarded as belonging to the genus Patella. In a note he says, "M. de Blainville en met la plupart dans ses Paracephalophores hermaphrodites non symétriques ou calyptraciens; mais ils me paraissent tous dioïques."

Another difficulty in studying this department of zoology arises from the circumstance that we have not the mollusks themselves before us for examination; we cannot observe them as we can any of the higher animals, study their habits and manners, and investigate their organization: and even if we could, we should find the anatomy and habits of many mollusks, separated from each other by naturalists into groups far asunder, closely approximating in these respects. Mostly, however, we have nothing but their shells before us, ranged in cabinets and making a beautiful show. So varied are their forms, so closely does one form approach another by a series of transitions, that even the situation of a species is often not only a matter of doubt, but is totally different in different systematic arrangements.

Added to all this, the varieties of many species are so decided, that whether they be really identical, or whether they should not rather be regarded as distinct, remains a question.

From these, then, and other causes, the study of conchology is one of great labour; it moreover involves little more than an attention to mere characters; and hence, beautiful as are shells to look at, the descriptive details can seldom be enlivened by a history of the habits and peculiar instincts of their molluscous tenants.

2736, 2737, 2738.—THE UNDULATED VOLUTE

(*Voluta undulata*). The Undulated Volute is so called from the waved lines with which the shell is ornamented; in figure, it is somewhat ovate and fusiform, with a smooth surface, of a yellowish white colour, clouded with fulvous or purple-black spots, and marked with numerous brown longitudinal undulating flexuous lines. There are four plaits or wreaths on the pillar, and sometimes two additional smaller ones. This species is found on the coasts of New Holland, Port Western, Bass's Strait, the island Maria, &c. Fig. 2736 shows the under surface or expanded foot of the mollusk protruded from its shell. Fig. 2737 is a lateral view of the shell, so as to display its general form, and show the orifice and the plaits on the pillar. Fig. 2738 is an upper view of the anterior part of the mollusk and its shell; the animal is prettily marked with zebra-like stripes. The respiratory siphon, the two tentacula, which are rather long, the eyes, each on a lateral prominence, and the broad expansion of the foot, are admirably displayed.

2739.—THE PACIFIC VOLUTE

(*Voluta pacifica*). Though the shell of this volute has the general outline of those of its genus, we observe that the angular part of the last whorl is marked by rather bold elevations, with depressions between them; and that a tendency to the same character occurs in the larger whorls of the spire. The ground-colour of the shell is pale yellow or flesh colour, with brown spotted bands, and bay vein-like markings. The pillar has five plaits. This species is found in the Bay of Islands, New Zealand. The figure exhibits an upper view of the shell and mollusk in the act of creeping. The tentacula are short; the respiratory siphon considerably developed.

2740.—THE BAT-VOLUTE

(*Voluta vespertilio*). In this species we find the projections of the shell more decided and acute; the spire too is muricated, the apex with small tubercles. The lip has a sinuous opening above for the reception of the respiratory siphon. The pillar presents four plaits.

The colour of the shell is white, yellowish, or reddish, painted with angularly flexuous spots; but it may be observed that the variations both of colour and markings, and also of the development of the spires and tubercles, are almost endless. Sometimes the spires are strong, sometimes scarcely perceptible. The Indian Seas, the coast of Amboyna, and the Moluccas, &c., afford this species.

2741, 2742.—THE EPISCOPAL MITRE

(*Mitra episcopalis*). In the genus Mitra the aperture of the shell is oblong, with several bold wreaths on the columella. The spire is in general pointed and elongated. The mollusk has the foot small, and the tentacles moderate, with the eyes on their lower part: the respiratory siphon does not project beyond the canal of the shell; the proboscis is often of enormous length.

Many species are very beautiful, and among them the present species holds a distinguished place. The shell is smooth, white, and spotted, with square or angular marks of bright red. The pillar has four plaits or wreaths, increasing in size from before backwards; the outer lip is denticulated at its lower part. The epidermis is very delicate. With respect to the mollusk, it has a narrow foot compressed and channelled at its root; its figure is a long triangle, the acute apex pointing backwards; the head is very small and rounded, with two short tentacles, at the base of which the eyes are seated. The short respiratory siphon is marked with black. A vermiform proboscis of extraordinary length, double that of the shell, constitutes a striking appendage to the head; it is terminated by an oval orifice at its dilated extremity. This species of mitre is a native of the Indian seas, and the coasts of the South Sea Islands, Tongataboo, &c.

Fig. 2741 exhibits the shell seen from below, with the mollusk visible; Fig. 2742 is the shell, showing the mouth and wreaths of the pillar.

2743.—THE TANNED MITRE

(*Mitra adusta*). In this species the shell is fusiform and turreted, and transversely streaked; the pillar has five wreaths. The general colour is whitish buff, with longitudinal rufous brown markings. There are two or three varieties. It is found near Timor, Vanikoro, &c.

2744.—THE WRINKLED MITRE

(*Mitra corrugata*). The shell of this mitre is ovate-fusiform, longitudinally plicated, transversely rugous; the whorls are angulated above, the last whorls with a submuricated angle. General colour whitish, with brown bands. It inhabits the Indian Ocean, the coast of New Guinea, &c.

From the genus Mitra we proceed to the genus Oliva, which is divided by M. Duclos into four groups, the Ancilloïd, the Cylindroid, the Glandiform, and the Volutellæ.

M. Rang, in his observations on the genus Oliva, in alluding to the presence of an operculum, pertinently remarks that this form is one of the few which incontestibly prove that the presence or absence of an operculum is valueless as a character upon which to divide the Pectinibranchiata into two primary sections, viz. Pomastomes and Apomastomes, or operculated and unoperculated, as has been attempted; for if, on account of the presence of an operculum, the Olives are removed to the first section, the result of such an arrangement would be to separate them from forms to which they are intimately allied both in their internal organization and the general characters of the shell (but in which no operculum exists), and consequently from which it would be unphilosophical to remove them. We may here add that the system of forming arrangements upon the absence on the one hand, and presence on the other, of certain structural peculiarities, irrespective of more important considerations, as in the instance in question, though it has had its supporters, is now utterly abandoned. It is the system called dichotomous, so severely criticized by Mr. MacLeay.

The mollusk of the Olive shell is characterized as being compressed, with a small head, terminated by a proboscis; the tentacles are placed close together, enlarged at their base, and slender at their points, and carry the eyes on small convexities about their middle part externally. The foot is very large, oblong, and slit transversely at its fore-part; the mantle sends forth a single lateral lobe, covering the shell in great part; it has two tongue-like processes at the side of the branchial opening, forming in front a very elongated siphon. The branchial pectination is single. There is a very small elongated horny operculum.

In the richness of their colours, and in the brilliancy of their shells, the Olives are among the most conspicuous; the species moreover are extremely numerous, M. Deshayes recording in his tables seventy-eight as now existing.

Beds of mud or sand, varying from a few feet below the surface of the water to twelve or fourteen fathoms, are the favourite haunts of the Olives; they are fond of flesh, but only suck the juices, and consequently continue long at their repast, adhering to their prey. Lieutenant Harford, who was for some time at the Mauritius, and who brought home very fine Olive shells, informed Mr. Broderip that off the shores of that island they are captured by means of baits, a sort of fishery for them being carried on. The method is as follows:—a line is made to run parallel with the bottom of the sea, and to this line at proper intervals small nooses, each containing a portion of the arms of a cuttlefish, are appended, so that the bait just touches the bottom. To one end of the line a chain-shot is attached by way of mooring, and over it are a buoy and flag; the other end of the line swings with the tide, and that end is also marked by a buoy and small flag. The sport is carried on in deep water over sand-banks, and the best times are morning and evening; occasionally the line is cautiously drawn up to the surface, and the Olives which are found adhering to the bait are taken by the fishermen into their boat.

2745.—THE FIGURED OLIVE

(*Oliva textilina*). In this beautiful species the shell is greyish white, subreticulated with flexuous dotted lines, and belted with two brown bands, inscribed as it were with characters. Lamarck gives the ocean of the Antilles as the locality of this shell, but according to the statement in the 'Voyage of the Astrolabe,' it is found around New Guinea.

2746.—THE RUDDY OLIVE

(*Oliva sanguinolenta*). The present species has a cylindrical shell very delicately reticulated, with rufous brown small lines, and girt with two brown zones: the pillar is orange red. Locality, the Indian Ocean, coast of Timor.

Referring to Fig. 2746, *a* is the shell seen from below; *b*, the animal out of the shell, shown as when creeping on its large foot.

2747.—THE BLACK OLIVE

(*Oliva maura*). The colour of this shell is black, with the aperture white; the apex is retuse. It is found in the Indian Ocean. In the 'Voyage of the Astrolabe,' Amboyna is given as a locality. Lamarck states that a yellowish variety is found along the coast of New Holland.

Fossil Volutidæ from the tertiary beds are rather numerous. M. Deshayes enumerates thirty-two species of Voluta, sixty-six of Mitra, thirteen of Oliva, seventeen of Marginella, nine of Ancillaria, two of Volvaria, and four of Columbella. To these must be added many other species; for example, Mr. Broderip has described and figured in the third volume of the 'Zoological Journal,' a voluta from St. Peter's Mountain, near Maastricht. Dr. Mantell notices a species from the blue clay of Bracklesham, and the arenaceous limestone or sandstone of Bognor; M. Lea enumerates seven species of Voluta from the tertiary of Alabama, five species of Mitra, eight of Marginella, and six of Oliva.

We may here take a review of the various modes in which different zoologists have arranged the Volutidæ, of which, since Lamarck's time, the number of known species, from the researches of naturalists, has been greatly increased; indeed some genera have had their numbers tripled, or even quadrupled, and fresh additions are continually being made.

Lamarck thus divided his genus Voluta:—

a. Shell ventricose, convex (bombée).

Les Gondolières (Cymbiolæ).

The species of this section belong mostly to the subgenera Cymba and Melo of Broderip.

b. Shell oval, spiny or tuberculous.

Muricinæ.

Comprising Volutæ imperialis, vespertilio, mitis, nivosa, &c.

c. Shell oval, tuberculous.

Musicales, the Music Shells.

Consisting of Volutæ ebræa, musica, &c.

d. Shell elongated, ventricose, nearly fusiform.

Fusoideæ.

Consisting of Volutæ magnifica, ancilla, pacifica, junonia, lapponica, &c.

Cuvier observes that the Volutes (*Voluta*, Linn.) vary in the form of the shell and that of the aperture, but are to be recognised by the notch without a canal which terminates it, and by the projecting and oblique plaits on the pillar. The following subdivisions appear in Cuvier's work:—

The Olives (Oliva, Brug.).

These are named from the oblong or elliptical

form of their shell, whose aperture is narrow, long, notched at the end opposite to the spire, which last is short. The plaits of the pillar are numerous and resembling striæ. The whorls are hollowed into a furrow. The shells of this genus do not yield in beauty to those of the cowries.

The animal of Oliva has a large foot, whose interior part (in front of the head) is separated by an incision on each side; the tentacles are slender and carry the eyes on the side, about the middle of their length. The proboscis, the siphon, &c. are long. There is no true operculum. MM. Quoy and Gaimard observed at the posterior part an appendage which is introduced into the furrow of the whorls.

Volvaria, Lam.

These much resemble the olives in their oblong or cylindrical form; but their aperture is narrow, and its anterior border ascends above the spire, which is excessively short. One or more plates at the lower part of the pillar. The polish and whiteness of these shells cause their employment as necklaces on some coasts.

The Volutes properly so called (Voluta, Lam.).

Cuvier characterizes the genus Voluta, Lam., as having a shell with an ample aperture, and the columella marked by large plaits, of which that which is farthest from the spire is largest. The spire, he observes, varies much in the extent of its projection.

Some of this genus, continues Cuvier (Cymbium, Montf.; Cymba, Brod.), have the last whorl ventricose. Their animal has a large, thick, fleshy foot, without an operculum, and on the head a veil, at the sides of which are the tentacles. The proboscis is rather long, and its siphon has an appendage on each side of its base. The shells grow to a large size, and many are very beautiful.

Others (Voluta, Montf.) have the last whorl conical, narrowing towards the end opposite to the spire. Their animal has not so large a foot as the preceding: their shells are also often very remarkable for the beauty of their colours or the patterns traced thereon.

Marginella, Lam.

With the form of the Volutes properly so called, these have the external lip of the aperture furnished with a bourrelet. Their notch is but little marked. According to Adanson, their animal, also, has the foot very large, and wants the operculum; it partially covers the shell by raising the lobes of the mantle. The tentacles carry the eyes on the external side of the base.

Columbella, Lam.

The plaits of the pillar are numerous, and the bourrelet of the external lip is convex or swollen as it were on its middle. These seem to have no operculum.

Mitra, Lam.

These have the aperture oblong, with some large plaits on the pillar; the plaits nearest to the spire are the largest. The spire is generally pointed and elongated: some of the species are beautifully spotted with red on a white ground. Their animal has a small foot; the tentacles, of moderate length, carrying the eyes on the side about the lower third: there is also a siphon of moderate length, but there is often a proboscis longer than the shell.

Cancellaria, Lam.

The last whorl of these is ventricose, the aperture ample and round, and the internal lip forms a plate upon the pillar. Their spire is projecting, pointed, and their surface generally marked with cancellations. ('Règne Animal.')

In Cuvier's system the Volutes are placed between Terebellum and Buccinum.

Of the Gastropods now usually arranged under the family Volutidæ, M. de Blainville places Oliva next to Terebellum. Ancillaria, Mitra, Voluta, and Marginella come in succession after Oliva. All these genera belong to M. de Blainville's third family, Angyostomata.

The genus Oliva is divided by this zoologist into the following sections:—

A. Oval species, with the spire scarcely projecting.

Example, Oliva undata.

B. Species a little more elongated, with the spire more projecting.

Example, Oliva litterata.

C. Species still more elongated (elancées), with a very projecting spire.

Example, Oliva subulata.

Ancillaria is divided by him into the following sections:—

A. Species with the spire sufficiently elevated and bucciniform.

Example, Ancillaria buccinoides.

B. Species with the spire almost null.

Example, Ancillaria cinnamomea.

Mitra is thus subdivided:—

A. Species elongated, turriculate, ribbed; the aperture very narrow, long, subcanaliculate, with a plait. (Genus Minaret, Montf.)

Example, Mitra tæniata.

B. Turriculate species, with large spiral whorls, the aperture effuse anteriorly.

Example, Mitra episcopalis.

C. Suboval species, with a shorter spire, ordinarily tuberculous.

Example, Mitra microzonias.

D. Oval species, with a very short spire, and ordinarily trellised.

Example, Mitra dactylus.

Voluta consists of the following sections:—

A. Elongated and subturriculate species.

Example, Voluta magellanica.

B. Oval species more or less tuberculous. (Genus Turbinellus, Oken.)

Example, Voluta imperialis.

C. Oval species, coroneted or not.

Examples, Voluta fulva and Voluta nivosa.

D. Oval, convex, ventricose species. (The Gondolières, Cymbium, Montf.)

Example, Voluta æthiopica.

Marginella is subdivided as follows:—

A. Species with the aperture less long than the shell, and with the spire apparent. (Marginella, Lam.)

Example, Marginella faba.

B. Species with the aperture as long as the shell, with no spire, and sometimes with it sunk or umbilicated.

Example, Marginella lineata.

C. Species which are still more involved; the aperture still narrower and longer; folds on the anterior part of the columellar lip; external lip delicate.

Example, Mitra monilis.

M. Rang thus defines the family of Volutes, which he makes his eighth family, placing it between the Enroulés of Lamarck and the Sigareti, thus:—

Animal furnished with triangular and flattened tentacles, carrying the eyes on the hinder part of them on the external side.

Shell oblong, with a large aperture, and furnished with plaits on the pillar.

Marine.

Genera Voluta and Cymbium.

The genus Voluta is thus defined:—

Animal oval; the head distinct, furnished with triangular and rather short tentacles, with sessile eyes at their base, placed a little backwards; mouth at the extremity of a thick proboscis, furnished with hooked teeth; foot very large and spreading, on all sides, beyond the shell, folding longitudinally in order to re-enter it; branchiæ composed of two pectinations.

Shell oval, rather ventricose, with the spire rather elevated and mammillated; aperture large, longer than it is wide, notched anteriorly; right lip arched; columella excavated, furnished with oblique plaits, the anterior of which are the greatest.

Following the example of Lamarck, M. Rang subdivides the genus into three groups:—1, the Muricines—Voluta imperialis, &c.; 2, the Musicales—Voluta ebræa, &c.; 3, the Fusoïdes—Voluta magnifica, &c.

The genus Cymbium, Adans., M. Rang defines thus:—

Animal oval, very convex, hardly capable of re-entering the shell, and spreading beyond it on all sides with its foot, which is very large: head furnished with a veil, whence issue two triangular and flattened tentacles with eyes situated at the external base of those organs, a little towards their external parts; an advanced proboscis with the mouth at its extremity.

Shell oblong oval, very ventricose, rather delicate; spire generally short and mammillated; aperture very large, longer than it is wide, notched anteriorly; right lip arched, trenchant; left or columellar lip excavated, furnished a little anteriorly to its middle with oblique plaits.

M. Rang remarks that this genus approaches closely to the preceding; but, at the same time, he states that he could find no veil in the animal of the Volutes, and that of Cymbium is evidently provided with it. Upon this ground alone M. Rang separates the genera; for, if the animals were the same, the species of Cymbium ought not to form more than a subgenus of Voluta. M. Rang further observes that Lamarck reckons fourteen species, a number which, he thinks, ought to be reduced rather than augmented, for the young individuals offer sometimes in their shell characters which disappear with age.

The genera Mitra, Ancillaria, Oliva, Volvaria, and Marginella are arranged by M. Rang under the family of Enroulés, in company with Terebra, Cypræa, and Ovula.

We may now pass on to notice the Auger Shells, les Tarières of the French, constituting the genus Terebellum of Lamarck. Cuvier places this group between the Ovulæ and the Volutes, and M. de Blainville between Conus and Oliva, while M. Rang regards it as a form between Mitra and Ancillaria. The shell is oblong with a narrow aperture, the columellar border being simple, without folds or wreaths, and slightly prolonged forwards. The animal is not known.

The species of the genus Terebellum are, as far as is yet ascertained, very limited in number, one living species only, we believe, being described, while of fossil species M. Deshayes notices only two, and these belong to the tertiary strata. Limited as this genus is, M. de Blainville divides it into two sections, viz. into *Terebellum* proper, which has the spire visible, and aperture shorter than the shell, and into *Seraphs*, in which the spire is nearly hidden by the rolling up of the whorls, while the aperture is nearly as long as the shell.

2748.—THE SUBULATE TEREBELLUM

(*Terebellum subulatum*). The shell is delicate and polished, of an elongated cylindrical figure, with the spire acute. Four varieties are described: the first is clouded with chestnut, four-banded, or with the colour in patches; the second, as in our pictorial specimen, is ornamented with flexuous subspiral or transversely oblique chestnut lines; the third is thickly dotted with rich chestnut; the fourth variety is entirely white.

2749.—THE CONVOLUTED TEREBELLUM

(*Terebellum convolutum*). This species and another, the T. fusiforme, are found in a fossil state only; they occur in strata of the Eocene period of Lyell, at Grignon, &c.

The Terebellum convolutum belongs to the subgenus Seraphs.

Family CYPRÆIDÆ (COWRIES).

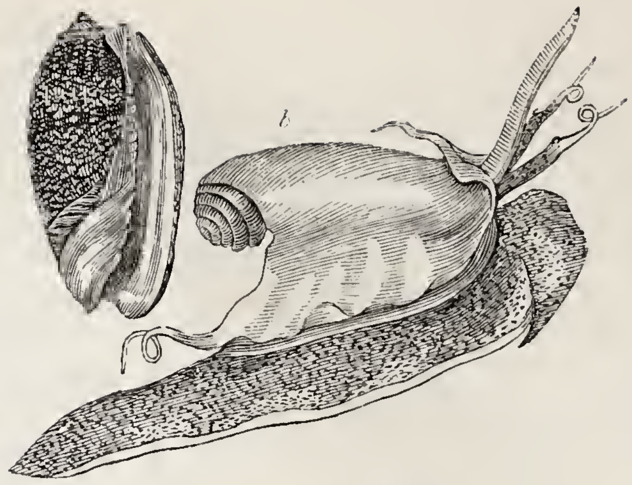
From the polish of their surface and the beauty of their markings, the Cowries are in considerable request in our island as chimney ornaments, and indeed, as a writer well observes, they "have been in demand among civilized and uncivilized nations, time out of memory." There is, in fact, a circumstance connected with the history of these shells, which proves the general interest taken in them, and the value (formerly greater than at present (in which they were estimated; we allude to the circumstance of their being used as coin, or in other words, of their constituting a portion at least of the currency of several countries. In many parts of India, in the Burmese empire, in Siam, &c., as well as on the coast of Guinea, and in Dahomy, they pass as money, though of course their value is trifling compared with that of gold or silver, and from their multiplication this value is on the decrease. We learn that in 1740 a rupee in Bengal was worth two thousand four hundred cowries; in 1760, two thousand five hundred and sixty cowries; and at the present time, upwards of three thousand two hundred. Accounts are still sometimes kept in the inferior departments of business in cowries, which are current as long as they remain unbroken. According to Kelly, four cowries make one gunda, twenty gundas one punn, four punns one anna, four annas one cahaun, and four cahauns one current rupee, but the last proportion is variable. The rupee is equal to 2*s.* 3*d.* of English money.

At Scindy, on the Malabar coast, cowries are also coin current.

The cowries used as current coin are obtained principally about the Philippine Islands, the Maldive Islands, and the coast of Congo; at these different localities they constitute an article of export. After the high tides, the women are occupied for three days in filling baskets with the sand with which the cowry shells are mixed; these are afterwards separated from the sand, and heaped on the shore, when the mollusks soon die; they are then ready for the market. The species is the Cypræa moneta of Linnæus.

The general characters of the adult shells of the Cypræa may be thus summed up:—texture highly porcellaneous; form oval or oblong, more or less rounded or cylindrical, with a small and imbedded spire; outer lip involute; aperture longitudinal, nearly straight, toothed or plaited on each side, with a channel or groove at each end. Very different, however, as we have previously remarked, is the young shell from the adult, and decided are the changes which it undergoes in its progress to maturity. Mr. Gray thus describes the change: "The shell alters its appearance considerably, according to the age of the individual, and exhibits three very distinct stages. In the young or first stages, which are figured in the 'Encycl. Méthod.,' t. 349, f. *a*, *b*; the 'Mus. Gotwald,' viii. t. 53, *b*, *e*; 65, *a*, *f*; 66, *a*, *c*, the shell is generally smooth, of a plain greyish colour, or with three transverse bands, and the upper part of the *inner* lip is smooth and convex, the lower part flat or concave; the *outer* lip is thin. In the second stage, the shell begins to

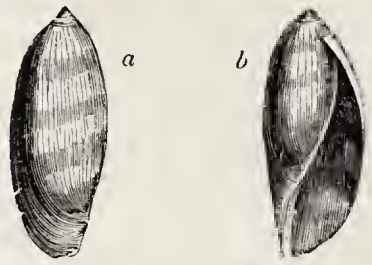
2744.—Wrinkled Mitre.



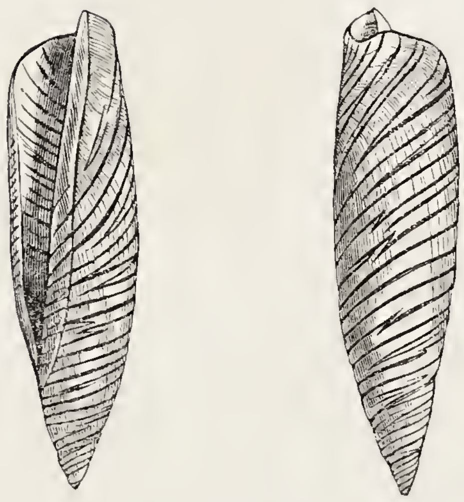
2746.—Ruddy Olive.

2745.—Figured Olive.

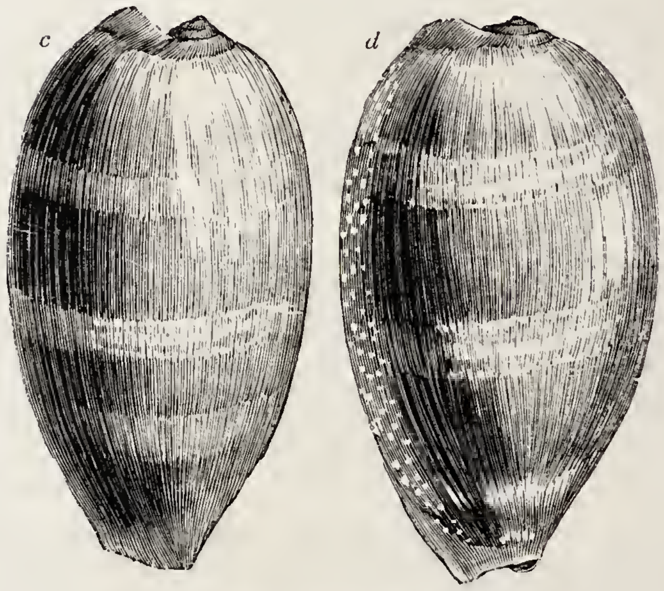
2747.—Black Olive.



2750.—Young Cowry.

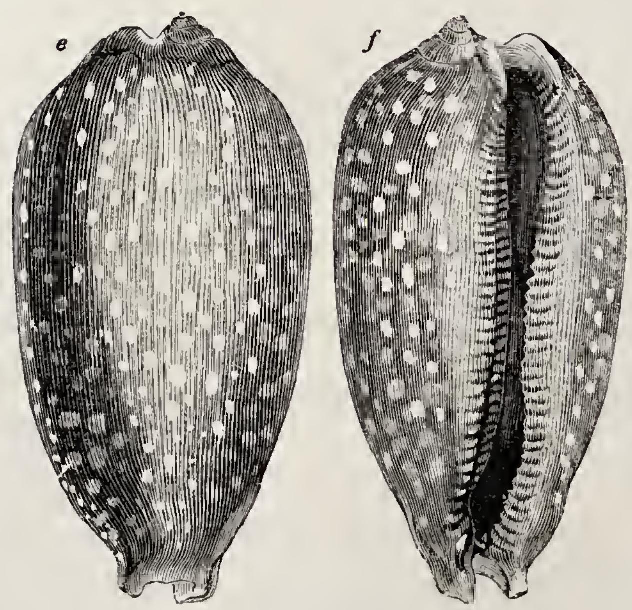


2743.—Subulate Terebellum.

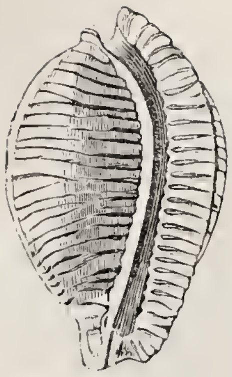


2751.—Young Cowry.

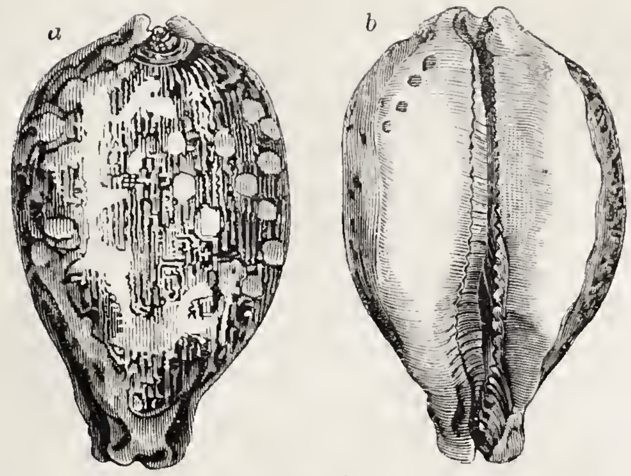
2749.—Convoluted Terebellum.



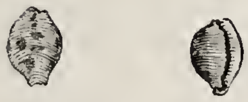
2752.—Cowry.



2758.—Blotched Cowry.

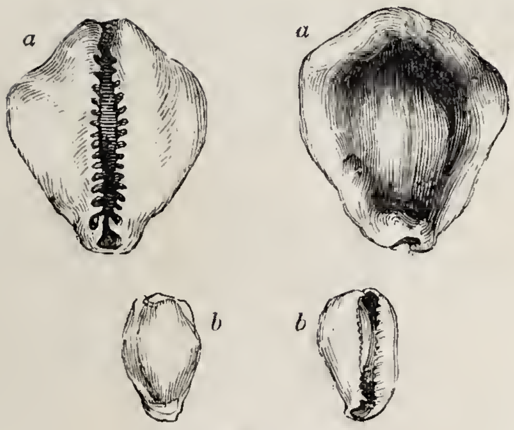


2753.—Map Cowry.

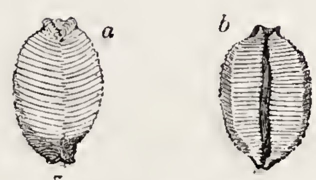


2757.—Adanson's Cowry.

2754.—Mole Cowry.

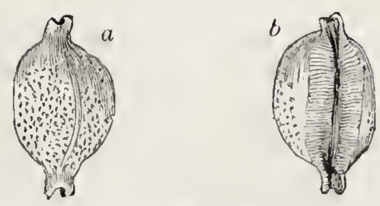


2759.—Money Cowry.



2756.—Children's Cowry.

2760.—Straitened Cowry.



2755.—Vetch-Cowry.

assume more the character of the genus, as the outer lip begins to be inflected or rather thickened, and approaches nearer the perfect appearance of the species as the second coat of colour is deposited; but it differs from the perfect shell in the want of thickness, in the spire being more distinct, and in the want of the dorsal line, which is usually distinct in the third or perfect state, when the last coat has been deposited (by the reflected mantle), and the aperture is more plaited on both sides. The colouring, or at least the disposition of colourings in the cowries, is a much more certain characteristic of species than either the general outline of form or size, the latter of which is exceedingly various. In this family I have often observed full-grown specimens of C. Arabica from one to three inches long. This peculiarity is attempted to be explained by Lamarck and others, who assert that when the animal has formed a complete shell, as it has not the faculty of enlarging its size, it is obliged to quit its shell and form a new one, in the same manner as the Annulosa cast their skins, and by that means the same animal forms many shells; but I believe there is not the slightest ground for this notion." Figs. 2750, 2751, and 2752 display the Cypræa exanthema in various stages. Fig. 2750 is the Young in the first stage: *a*, the back; *b*, the front view of the same, showing the columella and the thin edge of the outer lip. Fig. 2751, the same at more advanced periods: *c* exhibits the back; the apex is already sinking, and the thickened lips are formed; *d* shows the shell still more advanced; the mantle has begun to secrete the enamelled spotted layer on the side, but the transverse stripes are still visible. At Fig. 2752, *e* shows the perfect shell, back view. All traces of the transverse stripes are lost under the enamelling of the thickened spotted coat; *f* represents the opposite view of the same, from which the alteration in the character of the aperture may be appreciated.

The growth of the shell, however, in the cowry, so as to accord with the growth of the mollusk, is a subject of some difficulty, and has engaged the attention of many naturalists. Dr. Fleming, in his 'Philosophy of Zoology' (vol. ii. p. 403), after observing that the formation of porcellaneous shells must take place in a different manner from those which evidently increase in size by the application of fresh layers of shelly matter to the margin of the mouth, goes on to say: "If we attend to the form of a young shell belonging to the genus Cypræa of Linnæus, we may perceive that an addition of shelly matter to the margin of the aperture, in the manner in which it is applied to other shells, would not enlarge the cavity, but completely close the aperture. The increase of the shell (accompanied by a corresponding increase of its inhabitant) must take place, therefore, either by absorption of the accumulated shelly matter of the mouth, and an elongation in the direction of the greatest curvature of the shell, or the old shell must be thrown off, and a new one produced suited to the size of the animal. The former supposition has not been entertained; the latter is now generally received by naturalists. The inner coat of such shells appears to be a transudation from the body of the animal, and the outer one to be laid on the surface by the loose reflected lobes of the cloak (mantle). In many other shells, portions of matter more compact than the other parts may be observed spread on the pillar, and applied to the margin of the mouth by a similar process. Mr. Platt, in support of Réaumur's opinion that shells are formed by juxtaposition, against the objections of Mr. Poupart ('Phil. Trans.,' vol. liv. p. 43), erroneously considers the different sizes of the Cyprææ as depending on the thickness of the shell increasing according to age, without admitting a corresponding increase of the contained animal, or of the cavity for its reception. If we turn to Figs. 2750, 2751, 2752, illustrative of the young and adult of Cypræa exanthema, we shall find an increase of size in every direction, nor do we clearly see how any addition to the outer edge of the shell (at *b*) will bring it to the volume of the whorl seen at *f*.

Again, if we turn to the Money cowry (Fig. 2759), it would seem as if the outer lip of the young, in order to assume the figure presented by the same part in the adult shell, must be first absorbed and then remodelled, for a mere addition to its margin would only tend to close the aperture; and besides this, we have then to account for the increase of the shell in every direction, for it will be observed that the proportions of the young shell viewed on the back, and the figure of the columellar portion of the front of the young shell, are but little dissimilar from those of the adult shell, only upon a smaller scale. The convexity of the back in the adult is not only apparently larger, that is from increased external depositions adding to the thickness of the shell, but really so, corresponding to the room required internally for the accommodation of the increased mollusk. Now we cannot account for the increase of the boss of this shell, excepting on the supposition of a gradual internal absorption on the one hand, and a co-ordinate secretion and deposition of fresh matter on the other; or, on the circumstance of the young animal quitting its shell when straitened for room, and investing itself afresh.

Look again at Trivia Europæa (Fig. 2765: *a*, adult; *b*, young), in which, excepting in the form of the outer lip, the young and adult closely resemble each other in figure, though they differ in size. How, while keeping the proportions already attained, is the young shell to acquire the size of the adult? Surely by no additions to the margin of the outer lip and its consequent inflexion, for the outer lip has to extend outwardly, in addition to the thickening and inflexion of its edge, and the orifice is not at the same time to become contracted, but rather proportionally enlarged. Unless, indeed, we are prepared, with some naturalists, to consider a change of shell to take place, we must have recourse to the operations of gradual absorption and deposition according to the growth of the animal, and the necessity of enlargement in any given part of the shell more than in another part.

These observations, however, must be understood only as bearing upon young shells which closely resemble those of the adult in figure, with the exception of the involution of the outer lip, but yet are far inferior in size; at a very early stage the whorls of the Cypræa evidently increase in size in the ordinary way, as in the olive-shells, volutes, &c., by additions of shelly matter to the outer lip, and at this period the shell of the Cypræa closely resembles that of the Olive, but this resemblance by degrees disappears, and that before the full growth of the shell is accomplished. We learn that Mr. Gray has recently observed that sometimes, though rarely, the young shells of Cypræa, especially Cypræa Arabica, have the inner edge of the outer lip thickened, and furnished with a compressed sharp-edged series of teeth. It is in such a case that we must look for some other explanation of the mode of growth than by mere additions to this lip.

With regard to the mollusk of Cypræa, it may be described as unisexual, of an elongated figure, having the head distinct, with two conical or subulate tentacula of some length, at the external base of which are the two eyes, sessile on small projections. The mouth is vertical at the bottom of a small cavity, and contains a lingual riband beset with tentacles, and prolonged into the interior of the body. The mantle is bilobed, the lobes being very large, with extended aliform edges in the adult, capable of being reflected over the back of the shell so as to meet on the mesial line. The foot is oval, thin, and destitute of an operculum.

The Cypræidæ are very widely spread, being found in the seas both of the old and of the new world; it is, however, in the hotter latitudes that they are most numerous, and display the greatest development in point of size and the richest colouring. A few species occur in our European seas. In their habits the Cypræidæ are littoral, tenanting beds of sand, or creeping under large stones or rolled masses of coral.

In the 'Zoological Journal' will be found a monograph of the cowries, by Mr. Gray, which, together with the seventeenth number of Mr. Sowerby's 'Genera of Shells,' may be consulted with advantage.

The cowries are divided into several genera and subgenera, according to minor peculiarities in the form and characters of the shell; and these genera and subgenera in Mr. Gray's arrangement are again subdivided into minor sections. The genus Cypræa is subdivided into subgenera Cypræa, Aricia, and Naria.

In the first subgenus, Cypræa, the front of the columella is described as broad and deeply impressed; the shell is mostly smooth. The section *α* of this subgenus is thus characterized:—shell smooth, columellar pit transversely ridged, teeth of the inner lip generally long. (Gray.) As examples, Mr. Gray enumerates twenty-seven species, among which are Cypræa Aurora (the Morning Dawn, or orange cowry), the Cypræa princeps, the Cypræa tigris, and the following:—

2753.—The Map-Cowry

(*Cypræa mappa*). *a*, the shell seen from above; *b*, seen from below.

In this elegant species the shell is ovate, more or less ventricose, varied with deep brown or yellow lines and spots. The dorsal line is laciniated; the margin is thick spotted with black; teeth yellow. The map-cowry is extensively spread in the Indian seas, and is subject to considerable variation. Among these we may notice the rosy variety and the dark variety, from the Pearl Islands; the citron variety and the dwarf rich-mouthed variety, from the Mauritius.

The young shell is of a fawn colour, with obsolete spots and dashes.

In section *β* the shell is smooth, the columellar pit nearly smooth, the teeth of the inner lip short and indistinct. Of fifteen species enumerated by Mr. Gray, we select the following:—

2754.—The Mole-Cowry

(*Cypræa talpa*). Sardonyx cowry of Gray.

In this species the shell is oblong-ovate, subcylindrical; its colour is yellowish, with three darker bands; the subangular base and teeth are brown or black; the mouth pale. A variety of this species occurs which has received the title *exustus*; it is shorter in form and darker coloured, with the teeth smaller and closer.

In section *γ* the shell has the back warty or tuberculous, rarely smooth; and the base on each side of the aperture is ridged.

Three species are assigned by Mr. Gray to this section, of which we may select the Vetch-Cowry as an example.

2755.—The Vetch-Cowry

(*Cypræa cicercula*). *a*, the shell seen from above; *b*, seen from below.

The shell is subglobose, with a dorsal groove and scattered tubercles; the base is partly grooved. The general colour is yellow, dotted with brown; four spots are on the base.

A larger variety, as it is generally considered (C. globulus), is destitute of the dorsal furrow, and is more oblong and smooth.

A fourth section, *δ*, is characterized as having transverse ribs.

To this section Mr. Gray refers two species, of which one, the Cypræa rugosa, Broderip, is fossil; the other we have selected by way of example.

2756.—Children's Cowry

(*Cypræa Childreni*, Gray). *a*, the shell seen from above; *b*, from below. In both views the transverse striæ are to be distinctly seen.

A fifth section, *ε*, is distinguished by the shell having longitudinal and transverse ribs. One species only is noticed, viz. Adanson's cowry.

2757.—Adanson's Cowry

(*Cypræa Adansoni*, Gray). This rare species is somewhat pear-shaped, and of a white colour mottled with brown. Mr. Gray gives the Pacific Ocean, with a query, as its locality.

The next subgenus is Aricia; it is characterized by the front of the columella being flat or nearly so, and the back of the shell smooth.

The first subdivision, *α*, of this subgenus has the margin of the shell pitted on the upper edge. Mr. Gray enumerates fourteen species, of which the blotched cowry is one.

2758.—The Blotched Cowry

(*Aricia guttata*). Cypræa guttata.

This rare and beautiful shell is brown, spotted with a paler tint; the base and margin are white, with brown ridges. Mr. Gray gives the Red Sea, with a query, as its locality.

Subdivision *β*. In this group the margin is entire, and the teeth of both lips are extended more or less over the base. The species enumerated are thirty-seven.

2759.—The Money Cowry

(*Aricia moneta*). Cypræa moneta.

It is this species which is used in some parts of India and Africa as money, a circumstance to which we have already alluded. The shell is yellow, or white with a yellow ring; the margin and base are tubercular; the teeth of the inner lip moderate.

Some varieties occur destitute of a yellow ring, and with the margin and base less tubercular.

The young are whitish, with two dark bands, and in this state are the Cypræa icterinia of Lamarck.

Referring to the figure, *a*, *a* represent the adult shell in two views; *b*, *b*, the young, also in two aspects.

Subdivision *γ* is characterized by the margin being entire, the teeth of the inner lip very small, forming a slight ridge; the front of the columellar lip slightly concave, produced and toothed internally. Two species are enumerated.

2760.—The Straitened Cowry

(*Aricia angustata*). Cypræa angustata.

This cowry, which is brought from the coasts of New Holland, is of a whitish brown colour, minutely dotted with brown; the base is white, the margin closely dotted with black; the ends blackish.

The next subgenus is Naria, distinguished by the front of the columella being narrow, and dilated into a sharp-toothed ridge. The shell is smooth. A single species only is referred by Mr. Gray to this genus.

2761.—The Freckled Cowry

(*Naria irrorata*). Cypræa irrorata.

This small species is brought to Europe from the South Seas: the shell is ovate, and of a purplish

colour, freckled with yellow; the base is white and flat; the teeth large.

Leaving the genus Cypræa and its subgenera, the following genera are described by Mr. Gray, viz.: Luponia, Cypræovula, Trivia, Erato, and Ovulum.

In the genus Luponia the shell resembles that of a Cypræa, but the anterior part of the columellar lip is crossed by several irregular ridges without any distinct marginal one, and is internally narrow and flat. The shell is pear-shaped, smooth or cross-ribbed. Mr. Gray enumerates five species.

2762.—THE ALGOA LUPON

(*Luponia Algoensis*, Gray). This species, which is found about the Cape of Good Hope, in Algoa Bay, &c., has the shell of a pale colour, dotted with brown; the margin is dotted with black; the teeth of the inner lip are very small. A variety occurs with the teeth more or less obliterated.

The genus Cypræovula is allied to Cypræa, but the anterior end of the columella is covered with regular cross-ribs, like the rest of the base, internally produced into an acute toothed ridge. The shell is pear-shaped and cross-ribbed.

2763.—THE CAPE CYPRÆOVULA

(*Cypræovula Capensis*). Mr. Gray gives this as the only species of the present genus: it is extremely rare. The general colour is pale brown; the ribs are very thin. Its native locality is the Cape of Good Hope.

The genus Trivia closely resembles Cypræovula, but the front of the columella internally is concave and ribbed; the shell is subglobular and cross-ribbed.

Subdivision *α* has the mouth wide, the outer lip slightly inflexed; the shell equally ribbed. Mr. Gray enumerates five species.

2764.—THE FLESH-COLOURED PIG-COWRY

(*Trivia carnea*). The little shells of the genus Trivia, which occur along the shores of Europe, are, from some fancied resemblance, termed Pigs on our coast; Porcelli in Italy. Mr. Gray, indeed, observes that the common name for Cowries, Porcelain (or Les Porcelaines), is taken from an imaginary similarity between these shells and pigs, and refers to Fabius Colonna. The present species is oblong, thin, pellucid, and of a pure rose colour, with very thin distant continued ribs. The lips are whitish. A variety presents an indistinct dorsal groove.

Subdivision *β*, with the mouth narrowish, the outer lip wide, and the ribs of the back subequal and linear. Mr. Gray enumerates eighteen species.

2765.—THE EUROPEAN PIG-COWRY

(*Trivia Europæa*, Gray). Cypræa Europæa, Lam. The shell of this species is ovate-subglobose, ash or flesh coloured, with three black dots and a whitish dorsal streak. The ribs are close, rather thick, and whitish. The base is white; the outer lip wide.

A variety with the back unspotted, and with an indistinct dorsal groove, is referred by Mr. Gray to the Cypræa arctica, Montf.

The young shells are white and smooth.

Referring to Fig. 2765 *a*, *a* represent the adult shell in two positions: *b*, *b*, the young shell.

Subdivision *γ*, with the mouth narrowish, the outer lip arched, and with the ribs enlarged or tubercular near the dorsal groove.

Seven species are enumerated.

2766, 2767.—THE LOUSE PIG-COWRY

(*Trivia pediculus*, Gray). Cypræa pediculus, Linn. This species, which is very widely spread, is of an ovate form, of a pale reddish colour, with six square black dorsal spots. The ribs are rather thick, subrugose, and crowded; dorsal line narrow, base reddish. Mr. Gray gives the West Indies as its locality.

In the 'Proceeds. Zool. Soc.,' April 28, 1834, will be found the following passage, which may be found not altogether uninteresting:—

"Some notes by J. B. Harvey, Esq., Corr. Memb. Zool. Soc., were read; they accompanied a collection of shells and crustacea made by the writer on the coast of Devonshire near Teignmouth. The several specimens were exhibited.

"Among them were numerous individuals of Cypræa pediculus, Cypræa bullata, and Cypræa arctica.

"Of the former there are two varieties, one spotted and the other without spots. The spotted variety, Mr. Harvey states, is generally smaller than the plain one, and is less produced on the side near the apex. Cypræa bullata is found in the same localities as Cypræa pediculus, but it may be doubted whether it is the young of that species: it is so comparatively rare, that Mr. Harvey has dredged up only six specimens of it, while he collected more than a hundred of Cypræa pediculus. He possesses, moreover, young individuals of Cypræa pediculus, of smaller size than specimens of Cypræa bullata. In the latter the whorls are more produced at the apex, and the shell is so delicate as to be broken even by a slight fall.

"On Cypræa arctica Mr. Harvey remarks, that though its size and appearance are in favour of its being a young shell, he hesitates in referring it to the immature condition of the unspotted C. pediculus. His principal ground for doubt is the extreme rarity of Cypræa arctica. He inquires, however, whether the animal may not perhaps live deeply imbedded in the sand for a certain period before it comes to the surface, and thus generally elude the search of the conchologist until its shell becomes matured?"

Mr. Gray, as we have stated, refers the Cypræa arctica to the Trivia Europæa as a variety.

Fig. 2767 represents the Trivia pediculus with the living animal; its reflected mantle is seen covering the shell as it crawls on its expanded foot. *a* is a view of the upper surface; *b*, a lateral view.

Subdivision *δ*, with the mouth narrow; the ribs tubercular; the dorsal line distinct; the front of the columella smooth. Two species are enumerated.

2768.—THE PIMPLED PIG-COWRY

(*Trivia pustulata*). Cypræa pustulata, Lam.

This species is of a purplish brown; the ribs are studded with reddish brown black-edged tubercles. It is a native of the Pacific Ocean.

The next genus, Erato, is thus characterized:—spire conical, apex blunt; shell when young smooth; the adult with both lips finely crenulated; the columella concave, slightly plaited in a radiated manner, or smooth with two or three folds in front; the anterior canal straight, the hinder indistinct.

Seven species are enumerated.

2769.—THE ROUGHISH TEAR-SHELL

(*Erato scabriuscula*). Marginella Cypræola, Sowerby.

The shell of this species is ovate, turbinate, livid purplish, and minutely tubercular. The spire is conical; the dorsal line impressed: the mouth wide and whitish, the inner lip largely plaited its whole length; the teeth large. The young is smooth, with the lip thin and toothless. Its native locality is the South Pacific.

We now come to the genus Ovulum (Ovula, Lamarck), containing those remarkable shells commonly called Poached-eggs by collectors.

Cuvier, who regards the Ovules or Ovula as the type of a form distinct from Cypræa, but approximating to it, observes that they have the shell oval, and the aperture narrow and long, as the cowries, but with plaits on the side of the columella. The spire is concealed, and the two ends of the aperture are pretty equally notched, or prolonged into a canal. Linnæus confounded these shells with the Bullæ, from which Bruguières separated them on good grounds.

The mollusk has a large foot and an extensive mantle, which is partially reflected over the shell, a moderate blunt muzzle, and two long tentacles, which carry the eyes on their side at about the third of their length from the base. Montfort calls those shells Ovules, in a restricted sense, which have the outer edge transversely plaited; and he gives the generic title of Volva (les Navettes) to those in which the two ends of the aperture are prolonged into a canal, and also in which the outer edge or external lip is not plaited.

Mr. Gray gives the generic characters of Ovulum as follows, subdividing the genus into several minor groups:—

The shell, when young, is spirally striated; when adult, covered with a smooth enamelled coat; the inner lip is toothless; the outer toothed or crenated; the anterior and posterior canals are more or less elongated.

The subdivision *α* has the outer lip broad, inflated, rounded, and crenulated; the extremities short: the front of the columella rounded.

Of this subdivision Mr. Gray enumerates two species, of which one is the Common Poached-Egg.

2770.—THE COMMON POACHED EGG

(*Ovulum ovum*). Ovula oviformis, Lamarck; Bulla ovum Linn.

The Common Poached Egg has the back remarkably elevated and rounded; it is smooth and white externally; the inside is orange brown.

Subdivision *β*. The species in this subdivision have the outer lip inflected, broad, and toothed; the ends are short and curved: the posterior end has a tooth on the inner side; the front of the columella is expanded beneath. One species only is enumerated.

2771.—THE TWO-WARTED POACHED EGG

(*Ovulum verrucosum*). Bulla verrucosa, Linn.

This species of ovulum has an ovate shell with the back deflected angularly. The extremity is roseate. The young shells are closely striated, and the ends are tinged with brown. It is found in the Indian Seas.

Subdivision *γ*. The characters in this section closely approximate to those of the preceding. The outer lip is inflected, rounded, narrow, and toothed. Four species are noticed by Mr. Gray.

2772.—THE PEARL POACHED EGG

(*Ovulum margarita*). The shell of the Pearl ovulum is of a subglobose form, and pointed anteriorly; the base is convex; the front of the columella concave; the outer lip rounded. It is a native of the sea around the Friendly Islands.

Subdivision *δ*. Characterized by the outer lip being slightly inflected, narrow, and keeled externally, with the edge shelving inwards.

Mr. Gray enumerates seven species.

2773.—THE PEAR-SHAPED POACHED EGG

(*Ovulum pyriforme*). The shell is pear-shaped, attenuated anteriorly; the front of the columella concave; the outer lip shelves inwards. It is found on the coasts of New Holland.

Subdivision *ε*. In this subdivision the outer lip of the shell is thickened, inflected, and toothless; the front of the columella is flattened; a fold or ridge runs across the back, which becomes obliterated with age. The extremities are short. Nine species are enumerated.

2774.—THE GIBBOUS POACHED EGG

(*Ovulum gibbosum*). The gibbous ovulum is oblong and blunt, with an angular ridge across the back. The general colour is white, with the lips yellow. It is subject to variation in its relative length and breadth. It is obtained in different parts of the Atlantic Ocean.

Subdivision *ζ*. In this section the outer lip is thickened, inflected, and toothless; the extremities are elongated; the hinder conical and straight. Four species are enumerated.

2775.—GOODHALL'S FALSE SPINDLE

(*Ovulum longirostratum*). The shell in this species is fusiform, and thin; the beak very long and curved; the mouth linear, rather expanded anteriorly. General colour white. It is found in the Adriatic.

Subdivision *η*. In this section the outer lip is thickened, slightly inflected, and toothless; the front of the columella is rounded; the extremities very long. It constitutes the genus Volva of Montfort. See Cuvier's 'Règne Animal.' One species only is enumerated.

2776.—THE COMMON WEAVER'S SHUTTLE

(*Ovulum volva*). Bulla volva, Linn.

This shell is oval, and striated, with the beaks long and somewhat flexuous. It is flesh-coloured, with the outer lip pink. It is brought in collections from China.

With respect to the fossil Cypræidæ, it may be observed that fossil shells of this family do not appear to have been found below the Supracretaceous group. Mr. G. B. Sowerby, speaking of the genus Cypræa ('Genera'), says, "of these," the fossils, "we have several species in Britain, in the London clay and crag; many others are found on the Continent, as in the calcaire grossier in the environs of Paris; at Laugnan, near Bordeaux, and in Normandy; also in Italy and Piedmont; we have seen specimens of a very fine fossil species, nearly resembling C. mus, from the Netherlands: they seem to be confined to the newer formations." Lamarck enumerates eighteen fossil species of Cypræa and two of Ovulum. Deshayes, in his Tables, makes the number of living Ovula eighteen, and the number of fossil (tertiary) species six. Three species, O. spelta, O. birostre, and a new species, he makes both fossil (tertiary) and living in the Mediterranean, the Indian Ocean, and the Mediterranean respectively. The number of living species of Cypræa he makes one hundred and thirty-eight, and the number of fossil (tertiary) nineteen. He considers Cyprææ lurida (Medit.), rufa (ibid.), annulus (African Ocean), coccinella (European Ocean), a new species (Sicily), and another new species, Sphæriculata? Lam., with an unknown habitat, as both living and fossil (tertiary).

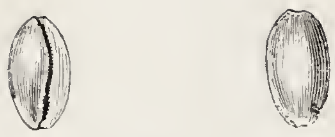
Mr. Gray notes the following as fossil:—

Cypræa.

Cypræa Physis, Brocchi (C. Pyrula, Lam.), Plaisantin or Placentin; C. leporina, Lam.; C. gibbosa, Gray; C. tumidula, König, Bordeaux: and he observes, that C. annularia, Brogn., appears to be an allied species; C. fragilis, Gray; C. Deshayesii, Gray; Ovula tuberculosa, Duclos; C. inflata, Lam., Grignon, allied to Ovulum; C. subrostrata, Gray, Nehove; C. fabagina, Lam.; C. diluviana, Gray; C. rugosa, Brod., Turin.

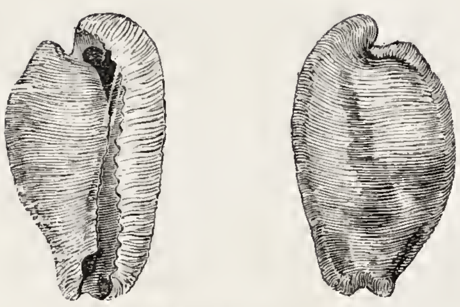
Luponia.

L. elegans, Gray; Cyp. elegans, Defr.; L. dactylosa, Gray: Cyp. dactylosa, Lam.; Cyp. Gervilii, Sow.; Cyp. Georgii, Defr.



2761.—Freckled Cowry.

2762.—Algoa Lupon.

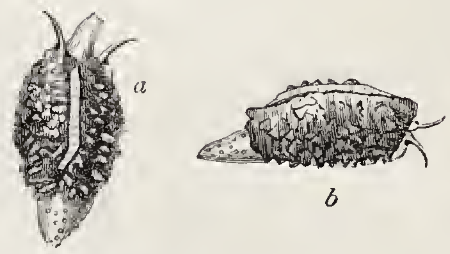


2763.—Cape Cypræovula.

2765.—European Pig-Cowry.

2764.—Flesh coloured Pig-Cowry.

2766.—Louse Pig Cowry.

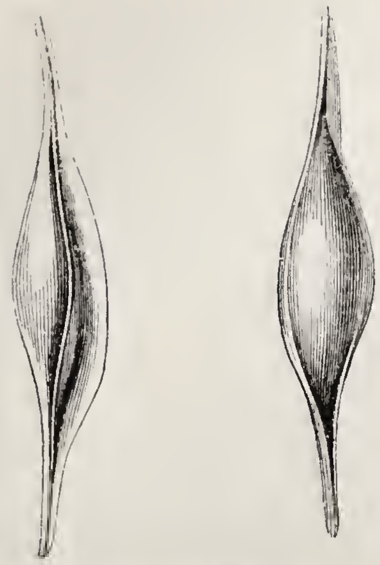


2767.—Louse Pig-Cowry.

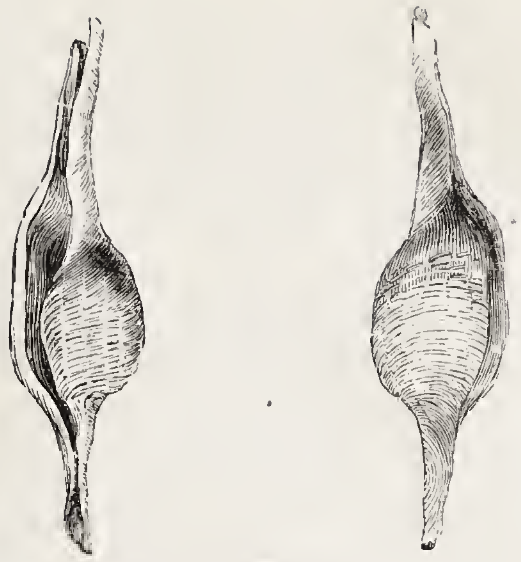
2768.—Pimpled Pig-Cowry.

2769.—Roughish Tear shell.

2770.—Common Poached-Egg.

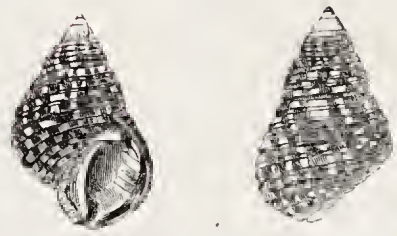


2775.—Goodhall's False Spindle.



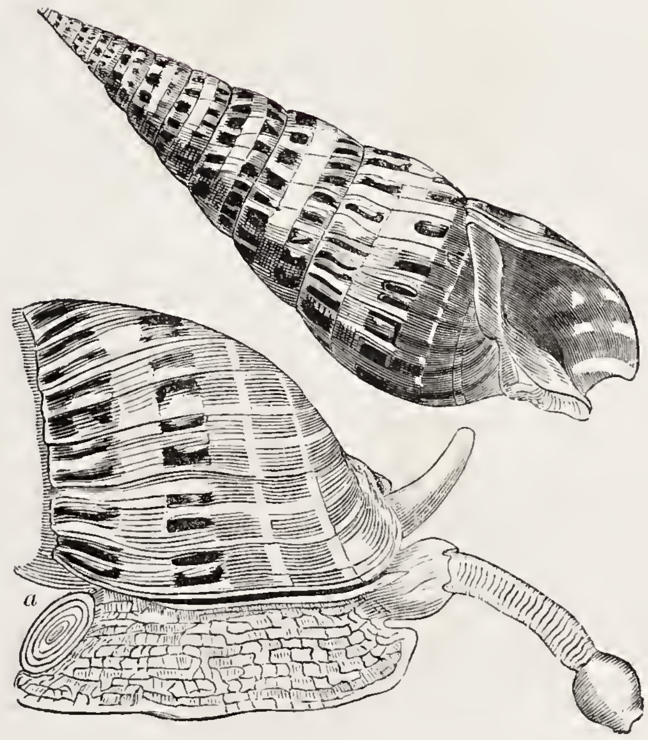
2776.—Common Weaver's Shuttle.

2772.—Pearl Poached-Egg.

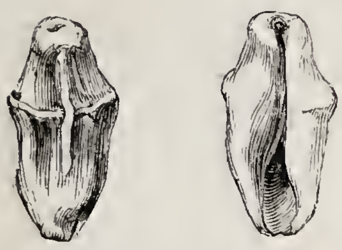


2777.—Sulcated Planaxis.

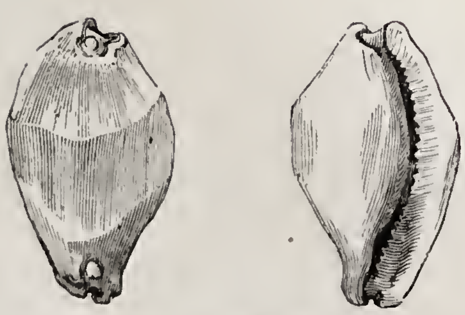
2773.—Pear-shaped Poached-Egg.



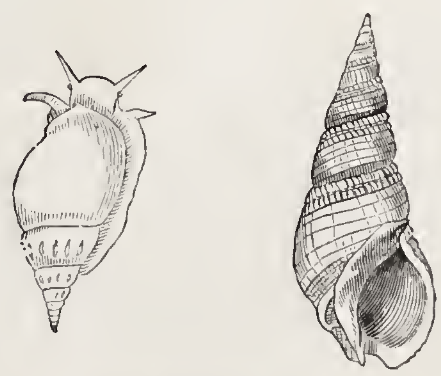
2778.—Spotted Subula.



2774.—Gibbous Poached-Egg.



2771.—Two-warted Poached-Egg.



2779.—Miran and Banded Terebra.

Trivia.

T. Bareinensis, Gray; Cyp. Barcinensis, König, Barcelona; T. sphæriculata, Cyp. Lam.? Italy; T. acuticostata, Gray, Italy; T. pediculoïdes, Gray, Italy; T. porcellus, Gray, Crag? T. Bronnii, Gray, Italy; T. solida, Gray; T. avellana, Sow., M. C., Suffolk Crag, which, Mr. Gray observes, appears to be an allied species; T. Duclosiana, Gray.

Erato.

E. ventricosa, Gray, Italy.

Ovulum.

O. Lethesii (Leathesii?), Sow., M. C.

Mr. Gray makes the whole number of species of Cypræidæ, including the subgenera above indicated, and the fossil as well as the living species, one hundred and seventy-four. If Cyp. nivosa, Brod., is to be considered as a well-established species distinct from Cyp. Dama, as Mr. G. B. Sowerby ('Zool. Journ.,' vol. iv., p. 220) and others contend, the number will be one hundred and seventy-five, provided C. Broderipii, Gray, be not also a variety of C. Dama, as Mr. Gray says it perhaps may be. To these are to be added eight living species recorded by Mr. Gaskoin, and one by Mr. Reeve, in the 'Zoological Proceedings' for 1835, as hitherto undescribed; and C. umbilicata, Sow., provided it be not a variety of C. pantherina, as Mr. Gray states it to be, but which Mr. Sowerby does not allow, considering it an established species more nearly allied to C. pantherina than C. Tigris.

Family BUCCINIDÆ (WHELKS, HARPSHELLS, &c.).

This family, the Entomostomata of M. de Blainville, and nearly the same with the genus Buccinum of Linnæus, comprehends, says Cuvier, all the shells which have no fold at the columella, but a notch, or a short inflected canal, towards the left.

We may add from M. de Blainville that the shell is variable in form, with the opening sometimes large, sometimes small, without any apparent canal, or with a short canal, curved upwards, and always more or less deeply notched anteriorly. The operculum is horny, nail-shaped, or oval, with subconcentric striæ, and the summit a little marked and marginal.

With respect to the mollusk, it is of a spiral form, with the foot shorter than the shell, and rounded in front. The mantle in front of the branchial cavity with a long respiratory tube or siphon, always uncovered, which the animal uses as an organ of prehension. The head is furnished with two tentacles, which carry the eyes on a basal enlargement. The mouth is armed with a proboscis, without any labial tooth, but furnished with a tongue. The branchiæ two, unequal, and pectinated.

The genera of this family are numerous: most are marine; some, however, live at the mouths of rivers, and a few are positively fluviatile.

The first genus which we may notice is Planaxis. The shell is stout, conical, and transversely furrowed; the aperture is oblong; the columella flat, truncated anteriorly, and separated from the right border or outer lip by a sinus. The inside of the outer lip is furrowed, with a thickened margin. The operculum is a delicate horny lamina, subspiral and oval. The animal does not appear to have been described, though M. Rang observed it in abundance at the Isle of France, where the rocks along the shore are sometimes covered with them; unfortunately he lost his notes, and is consequently unable to give any particular details, but according to his recollection the mollusk differed little from that of Phasianella. He states that he possesses six well distinguished species.

2777.—THE SULCATED PLANAXIS

(*Planaxis sulcata.*) The Sulcated Planaxis, like the other species of this genus, is littoral in its habits, frequenting rocky shores, and often hiding itself under stones. It is common in the Isle of France.

Several fossil species of Planaxis occur in beds of the tertiary series.

Another genus is that termed by M. de Blainville Subula, and which he states that he found himself compelled to establish, upon examining the animal brought home by MM. Quoy and Gaimard, the shell of which had hitherto been placed in the genus Terebra. In the genus Subula M. de Blainville arranges all those species which have the shell greatly elevated, with a very pointed spire, the whorls being at the same time ribanded. It will therefore include the greater number of the species described by Lamarck as Terebræ, and which nearly all belong to the East Indies and Australasia. It may be observed, that Mr. Gray, who on July 8th, 1834, described an extensive collection of shells of the genus Terebra (see 'Proceeds. Zool. Soc.' 1834, p. 59 et seq.), does not notice M. de Blainville's genus Subula, and that M. Rang considers it desirable that new observations be made on the animals in order that the line of separation between the Subulæ and Terebræ may be established.

The characters of Subula, as given by M. de Blainville, are essentially as follows:—

The shell is destitute of an epidermis, turriculated, and with a pointed spire; the whorls are smooth, ribanded, and bifid. The aperture is small, oval, and deeply notched anteriorly; the outer lip is thin and sharp-edged; the inner or columellar lip has an oblique roll or fold at its extremity. The operculum is horny and lamellar; its figure oval.

The mollusk is spiral, very much elevated, with a short round foot; the head is small, with triangular tentacula bearing the eyes at their summit. The proboscis is very long, without hooks, and the mouth is unarmed.

2778.—THE SPOTTED SUBULA

(*Subula maculata*). Buccinum maculatum, Linn.

This elegant shell is found at the Moluccas and other islands. Lamarck observes that a specimen in his possession was brought from Hawaii or Owhyhee. The uppermost of the two figures exhibits the shell only; the lower figure, the last whorl of the shell with the animal in the act of creeping along. The operculum is distinguished by the letter *a*.

We now turn to the genus Terebra, which we shall find very differently characterized by M. de Blainville and Mr. Gray.

The former gives the following details: "Animal spiral and rather elevated; foot oval, with a transverse anterior furrow, and two lateral ear-like appendages: head bordered by a small fringe; tentacula cylindrical, terminated in a point and distant from each other; eyes but little apparent at the origin and outside of the tentacula: mouth without a proboscis; tube of the respiratory cavity very long. Shell without an epidermis, inclining to oval; spire sharp, not much elevated, or subturriculated; aperture large, oval, and strongly notched anteriorly; columellar lip with an oblique fold (bourrelet). No operculum."

In the 'Proceeds. Zool. Soc.' already referred to (1834, p. 59) Mr. Gray thus characterizes Terebra:

"The animal has a small foot and a very long proboscis; at the base of which are seated two very small tentacula. The operculum is ovate, thin, horny, rounded behind, and rather tapering in front. The shell is covered by a very thin pellucid horn-coloured periostraca (epidermic layer); it is usually white, variously streaked with brown, the streaks being often interrupted or broken into spots by the two spiral bands of the shell: one of these bands is placed near the spiral groove, and the other on the middle of the whorl. The apex of the cavity is frequently filled up by a calcareous deposition."

The characters here given by Mr. Gray are evidently descriptive of M. de Blainville's Subula; which the former, it would appear, does not admit as distinct: but, on the other hand, the Terebra as characterized by M. de Blainville must be distinct from the Terebra of Mr. Gray; and if this name be appropriated to the forms associated under it by the latter naturalist, then a fresh name will be required for the Terebra of De Blainville.

In the 'Proceeds. Zool. Soc.' already quoted Mr. Gray describes forty-five species, of which twenty-one were new; all of them either in the British Museum or in his own private collection.

2779.—THE MIRAN, AND THE BANDED TEREBRA

(*Terebra* ——? [*Vis Miran*] *et Terebra vittatata*).

The figure on the left hand is the Miran from Adanson; that on the right is the Banded Terebra.

The Terebræ, like the Subulæ, are natives of the warmer latitudes, occurring in depths ranging from the surface to seventeen fathoms. Occasionally they creep on reefs out of the water, but always within the reach of the spray.

The Terebræ and Subulæ occur in a fossil state, in the beds of various epochs. Some are found in strata below the chalk, as the Portland stone in Dorset, South Wiltshire, North Wiltshire, Oxford, and Bucks. They also occur in the Claiborne beds, in the oolitic series, in the London clay, and in beds of the tertiary system.

Closely allied to the genus Buccinum we find the genus Eburna, characterized by the shell being oval, elongated, and smooth, with the spire pointed, and the whorls not divided from each other by a deep suture, and therefore but moderately marked; the aperture is oval, elongated, and deeply notched anteriorly; the right lip is entire, the columellar lip umbilicated, callous posteriorly, and slightly channelled at its external part.

2780.—THE SMOOTH EBURNA

(*Eburna glabrata*). Buccinum glabratum, List.

These Eburnæ, of which only a limited number of species are known, inhabit the seas of warm climates: Lamarck assigns three to the East Indies, and one to South America. Fossil species occur in tertiary formations; but they appear to be rare.

We may now turn to the genus Buccinum, of which the Common Whelk or Waved Whelk is a familiar example.

The shell is oval, elongated, pointed, with the spire moderately elevated; the aperture is oblong or oval, deeply notched anteriorly; the right lip is entire, sometimes thick; the columella simple or callous; the operculum horny. The species are extremely numerous and widely distributed. They are littoral in their habits, and range at various depths from the surface to seventeen fathoms. Two species, the Buccinum glaciale and B. Sabinii, were met with by Captain Parry within the regions of the arctic circle.

2781.—THE WAVED OR COMMON WHELK

(*Buccinum undatum*). This species abounds everywhere on our coast, where it creeps about in search of prey, boring holes with its proboscis through the shells of other mollusks for the purpose of sucking the juices of the unfortunate prey. In order to accomplish this it uses a sort of tongue or retractile filament, armed with minute teeth, with which its proboscis is furnished, and which acts as a sort of drill, or rasp-like perforator.

The empty shells of the whelk, scattered about at random on every beach, are appropriated by the Hermit Crab (Pagurus), who ensconces himself within, and guards the entrance. The shell of the Purpura Lapillus (Buccinum Lapillus) is also similarly occupied by this crab, which thus protects its soft body from the rough waves and shingles or sharp stones of the sea-shore, over which he wanders prowling in quest of his prey.

The common whelk is boiled and eaten, and numbers may be seen exposed for sale, as food, in the street-stalls of the metropolis. Like the periwinkle, they are coarse and indigestible.

It was from a species of whelk that the Tyrian dye of ancient times was procured, but to this we shall have occasion to allude in our notice of the genus Purpura, now separated from Buccinum.

The number of fossil Buccina is very considerable; M. Deshayes records ninety-five species, including those of the genus Nassa, which he does not separate from Buccinum. Dr. Felton, in his 'Stratigraphical and Local Distribution,' notices two species below the chalk in the Portland Stone; and Mr. Lea observes twenty-seven species occur in England, several as low as the mountain limestone, but mostly in the London clay and the crag formations, the genus being more abundant in the upper than in the lower formations. The Pliocene of the Subapennines, he adds, presents us with twenty-seven species; the Miocene strata about Bordeaux twenty-one; the Eocene around Paris nine. Four species have also been found in North America, in the older Pliocene.

With regard to the genus or subgenus Nassa, it is distinguished by Cuvier from having the side of the columella covered by a large plate more or less broad and thick; the notch, besides, is very deep, but there is no canal. The animal is a true whelk in figure, and there are many transition links between the shells of this subgenus and Buccinum.

In their habits the Nassæ resemble the Buccina; they mostly live in the warmer seas, a few species only being European.

Another genus is termed Harpa, which is easily to be recognised by the bold transverse salient ribs on the whorls; the shell is delicate, enamelled, and convex, the last whorl very ample; the right lip extensive and deeply notched anteriorly. According to the statements of M. Reynaud and other observers who have examined the living animal, there is no operculum.

The mollusk has a large head destitute of a proboscis, the mouth opening below; the tentacula are conical, and carry the eyes on a slight external basal enlargement. The respiratory siphon is elongated. The colour of the mollusk is a rich vermillion red. About eight species are recorded. All are natives of the warmer seas, and especially around the Mauritius and the adjacent islands, where the finest specimens are procured, and where, indeed, a sort of fishery for these shells is carried on; so prized are they by collectors for the beauty of their colouring and the elegance of their form.

The men engaged in fishing for these shells take advantage of the ebb tide, and at low water visit the reefs and sand-banks during the night or at day-break, the animals being then, as it is supposed, wandering about in quest of food: they use a rake to which a net is attached, and the latter receives the shells which the rake catches in its progress. Occasionally when the men are fishing with baited lines for olives, they draw up harps at work upon the bait.

2782.—THE VENTRICOSE HARP

(*Harpa ventricosa*). This fine species is found on the coast of the Mauritius; it is very valuable, but

less rare and costly than the Harpa imperialis; all the species, however, are depressed in value now, to what they were some few years since.

It is a remarkable circumstance, of the truth of which we are assured by MM. Quoy and Gaimard, and also by M. Reynaud, that when suddenly alarmed or threatened with instant danger, the mollusk forcibly draws itself up into the recesses of its shell, disembarrassing itself of the posterior part of the foot, which, according to M. Reynaud, being too voluminous to be retracted within the shell, suffers amputation from the edge, against which it is forced by the contractile action of the muscular system.

It would be very interesting to know whether, as is most probable, the part thus cut off becomes renewed; and whether the mollusk has been observed to act thus not only when caught and roughly handled by man, but when alarmed under the water by other enemies.

We believe that only about two species of fossil Harpa have been discovered, both in some of the tertiary formations near Paris.

We may now turn to the genus Dolium. In this genus the shell is light and delicate, of a somewhat globular figure, with a large aperture, and a twisted columellar lip. The last whorl forms nearly the whole of the shell, the spire of which is small. The right lip is undulated, and the whorls are furrowed externally in the direction of their tournure, or transversely to the shell. The operculum is horny.

2783.—THE HELMET DOLIUM

(*Dolium galea*). The Dolium galea is a native of the Mediterranean, but most of the species are found in the warmer seas, and especially those of India. They mostly tenant reefs and beds of rock; some are of large dimensions.

Montfort divides this genus into the Tuns (Dolium) and the Partridge Tuns (Perdix). The former have the base of the columella twisted, in the latter it is trenchant.

According to Cuvier the mollusk has a very large foot expanded anteriorly, a proboscis longer than the shell, and slender tentacles with eyes at the base. He adds, the foot is not provided with an operculum. But this appears to be an error.

The fossil species are limited in number and very rare. Another genus in the present family is Cassidaria, distinguished by an ovoïd ventricose shell, with the spire but little elevated. The aperture is long and rather narrow, and produced anteriorly in the form of a recurved canal; the outer lip is thickened with a fold; and the columellar lip is covered by a large callosity; the operculum is horny.

2784.—THE SPINOUS CASSIDARIA

(*Cassidaria echinophora*). The species of this genus are comparatively limited in numbers. They are widely distributed, but chiefly tenant the warmer seas. The spinous Cassidaria is found in the Mediterranean.

A few fossil species occur in tertiary deposits. From the genus Cassidaria Mr. G. B. Sowerby has separated certain species, upon which he establishes the genus Oniscia. The shell is oblong and subcylindrical, with the apex rather obtuse, and the spire short; the aperture is elongated, and extended into a short canal; the outer lip is thickened and denticulated within; the columellar lip is expanded and covered with granules; externally the shell is tuberculated or ribbed. Of the mollusk nothing is ascertained.

2785.—THE CANCELLATED ONISCIA

(*Oniscia cancellata*). We figure this species as an example of the present genus, of which three species are described by Mr. Sowerby from specimens now in the British Museum, but formerly constituting part of Mr. Broderip's noble collection. A fossil species from the tertiary deposits in Italy is recorded, and figured by Mr. Sowerby. Of the habits of the Onisciæ little is known, excepting that they are littoral, frequenting banks of sand.

According to its describer the genus Oniscia is intermediate between Cassidaria and Cassis.

The genus Cassis contains numerous species distinguished by the convexity of the shell, of which the spire is nearly flat, the aperture oblique, narrow, and elongated, with the anterior canal short and recurved; the right or external lip is thick with a bold reflexion, and is toothed internally; the columellar lip is extensively callous, with long and deep transverse rugæ; the operculum is horny and very small. M. de Blainville divides this genus into two sections, the first containing those species which have the aperture long and the outer lip nearly straight; the second containing those which have the aperture suboval, and the external lip excavated.

2786.—THE TUBEROSE CASSIS

(*Cassis tuberosa*). This species is an example of M. de Blainville's first section; it is a native of the West Indian Seas. The lower figure represents the denuded mollusk of Cassis sulcata.

M. Deshayes enumerates thirty living species belonging to the genus Cassis, all, with the exception of two or three which are found in the Mediterranean, belonging to the hotter latitudes. They tenant beds of sand, ranging from five to ten fathoms in depth. About fifteen fossil species are known, all belonging to tertiary deposits.

Closely allied to the two preceding forms is the genus Ricinula, which is characterized by M. de Blainville as follows:—The shell is oval, or subglobular, thick, and beset with points or tubercles; the spire is very short; the aperture is narrow and long, with a notch anteriorly; the right lip is often digitated externally, and toothed within; the columellar lip is callous and toothed or wrinkled; the operculum is horny, oval, and concentrically striated.

The mollusk very closely resembles that of Buccinum. The mantle is provided with a tube, the foot is wide, with appendages anteriorly; the head is of a semilunar shape, with conical tentacles with the eyes on their outer surface, near the middle.

M. de Blainville enumerates nine species, all natives of the Indian Seas, where they tenant coral reefs and rocks. M. Deshayes in his tables gives the number of recent species as fourteen, and he also records one fossil species found in the tertiary deposits, near Bordeaux, Dax, and Turin.

2787.—THE SPINOUS RICINULA

(*Ricinula horrida*). M. de Blainville separates Ricinula into three sections, of which one is distinguished by the presence of a canal anteriorly and behind the orifice, the second has no canal and is beset with spines, the third is also destitute of a canal, and is studded with tubercles. The spinous Ricinula belongs to the second section.

We now come to the genus Cancellaria.

In this genus the shell is oval or globular, thick, and reticulated; the spire is slightly elevated and pointed; the aperture demi-oval, with a notch or short canal anteriorly; the right lip is sharp-edged and striated within; the columellar has many plaits or wreaths; the operculum is horny.

The mollusk is stated to resemble in all essential characters that of Buccinum.

2788.—THE RETICULATED CANCELLÁRIA

(*Cancellaria reticulata*). The Cancellariæ are natives of the seas of the hotter latitudes, where they tenant sandy beds, ranging from seven to sixteen fathoms in depth. M. de Blainville describes twelve recent species, mostly from the Indian and African seas; and in the 'Proceeds. Zool. Soc.' for 1832, p. 50 et seq., will be found the characters of twenty-two new species, brought by Mr. Cuming principally from the Pacific side of Central and South America: one species, the Cancellaria hæmastoma, Sowerby, is from the Gallapago Islands; it is extremely beautiful, nearly white, with a broad dark brown band, and a brilliant orange-coloured mouth.

The reticulated Cancellaria is found in the South Atlantic ocean.

The fossil species of Cancellaria are tolerably numerous. M. Deshayes enumerates forty-two as occurring in tertiary deposits, one of which is identical with a living species. Mr. Lea describes and figures eight additional species from the tertiary formation of Alabama; he observes that in England the genus has been found only in the London clay, whence three species have been obtained. With respect to the species enumerated by M. Deshayes he remarks that sixteen are from the Subapennines, the Pliocene of Mr. Lyell, twelve from the Miocene of Bordeaux, five from the Eocene near Paris. Previously to his description of the eight species from Alabama, a single one only had been known as American, viz., the Cancellaria lunata, from the tertiary beds of St. Mary's.

We now pass to the genus Purpura, so called in allusion to the dye which some of the species afford, and which entered into the composition of the Tyrian purple. The shell is thick, smooth, or tubercular, with a short spire, and a dilated aperture, and of an oval form, terminated anteriorly by a small notch; the columella is flattened, and terminates anteriorly in a point; the right lip is sharp, and often thickened and furrowed internally, or produced anteriorly into a conical point. The operculum is horny and semicircular.

With regard to the mollusk, it is elongated and widened in front; the head is large and furnished with a very short proboscis: there are two conical tentacula, approximated at their base, with the eyes placed on an enlargement near the middle of their external part: the mouth is hidden by the foot, which is ample, considerably advanced anteriorly, with a semilunar marginal outline.

The Purpuræ are very numerous, and widely distributed, principally in the warmer seas, a few only being European. Most are from the coasts of South America.

M. de Blainville, who divides the genus into four sections, enumerates fifty species of Purpura, besides five of his section Monoceros. M. Deshayes gives seventy-six species of living Purpura, and six of Monoceros, but to these other species have been added by Mr. Broderip, Mr. Sowerby, and other naturalists, principally from Mr. Cuming's collection.

2789.—THE PERSIAN PURPURA

(*Purpura Persica*). This shell is an example of the patulous section without a tooth at the lip, and with a wide aperture. The accompanying mollusk belongs to the Purpura hæmastoma.

2790.—THE IMBRICATED PURPURA

(*Purpura imbricata*). Monoceros imbricatum, Lam.

This species, from South America, is an example of the section Monoceros, in which the right lip near the notch is armed with a conical spine or tooth, pointed, and more or less curved.

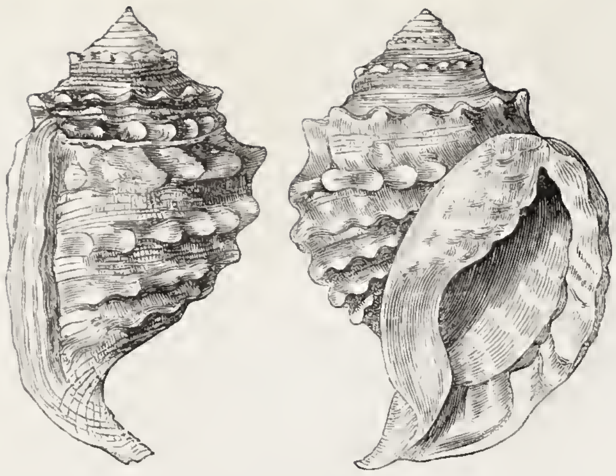
The Purpuræ are all littoral in their habits, some tenanting sandy beds, others rocks and reefs, ranging from the surface of the water to twenty-five fathoms in depth. The Purpura lapillus is common on our shores, occurring in great abundance on rocks at low water, and is one of the British mollusks producing a purple dye, analogous to the purpura of the ancients.

It must not be supposed that the Tyrian purple of the ancients was a colour similar to that which we now term purple: it approached our scarlet, or at least had in it a tinge of that colour; the most superb hue, according to Pliny, was amethystine, and this was produced by the juice of the Buccinum and Purpura mixed. "Another tint was obtained by saturating a stuff, which was at first amethystine, in a bath of the Tyrian purple, so that the dyer tints at first conchylian to facilitate the Tyrian tincture, which then becomes softer and more agreeable." The following observations under the article 'Dyeing,' in the 'Penny Cyclopædia,' are very interesting, the more so as they are written by one well acquainted with the modern methods of imparting colour to different stuffs. He says, "In the article 'Calico Printing' we have shown from Pliny that the ancient Egyptians cultivated that art with some degree of scientific precision, since they knew the use of mordants, or of those substances which, though they may impart no colour themselves, yet enable white robes (candida vela) to absorb colouring drugs (colorem sorbentibus medicamentis). Tyre, however, was the nation of antiquity which made dyeing its chief occupation and the staple of its commerce. There is little doubt that purple, the sacred symbol of royal and sacerdotal dignity, was a colour discovered in that city, and that it contributed to its opulence and grandeur. Homer marks the value as well as antiquity of this dye, by describing his heroes as arrayed in purple robes. Purple habits are mentioned among the presents made to Gideon by the Israelites from the spoils of the kings of Midian.

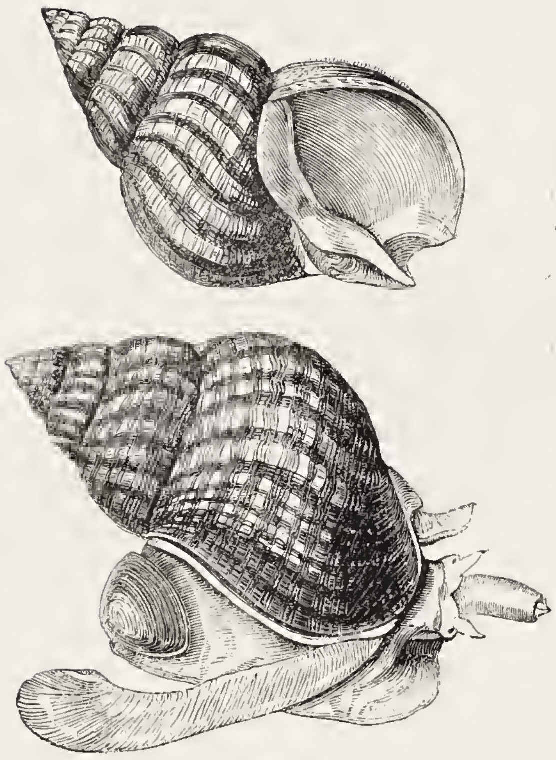
"The juice employed for communicating this dye was obtained from two different kinds of shell-fish, described by Pliny under the names of purpura and buccinum; and was extracted from a small vessel, or sac, in their throats, to the amount of only one drop from each animal. A darker and inferior colour was also procured by crushing the whole substance of the buccinum. A certain quantity of the juice collected from a vast number of shells, being treated with sea-salt, was allowed to ripen for three days; after which it was diluted with five times its bulk of water, kept at a moderate heat for six days more, occasionally skimmed to separate the animal membranes, and when thus clarified was applied directly as a dye to white wool, previously prepared for this purpose by the action of lime-water, or of a species of lichen called fucus. Two operations were requisite to communicate the finest Tyrian purple: the first consisted in plunging the wool into the juice of the purpura; the second, into that of the buccinum. Fifty drachms of wool required one hundred of the former liquor, and two hundred of the latter. Sometimes a preliminary tint was given with coccus, the kermes of the present day, and the cloth received merely a finish from the precious animal juice. The colours, though probably not nearly so brilliant as those producible by our cochineal, seem to have been very durable, for Plutarch says, in his 'Life of Alexander' (chap. 36), that the Greeks found in the treasury of the king of Persia a large quantity of purple cloth, which was as beautiful as at first, though it was 190 years old.*

* "Among other things, there was purple of Hermione (?) to the amount of five thousand talents." (Plutarch's Lives, translated by Langhorne, Wrangham's edition, vol. v., p. 2₄0.) Horace celebrates the Laconian dye in the following lines:—

Nec Laconicas mihi
Trahunt honestæ purpuras clientæ.
Carm., lib. ii., Ode 18.

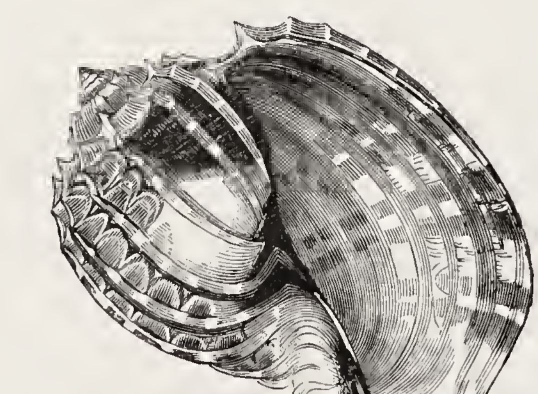


2784.—Spinous Cassidaria.

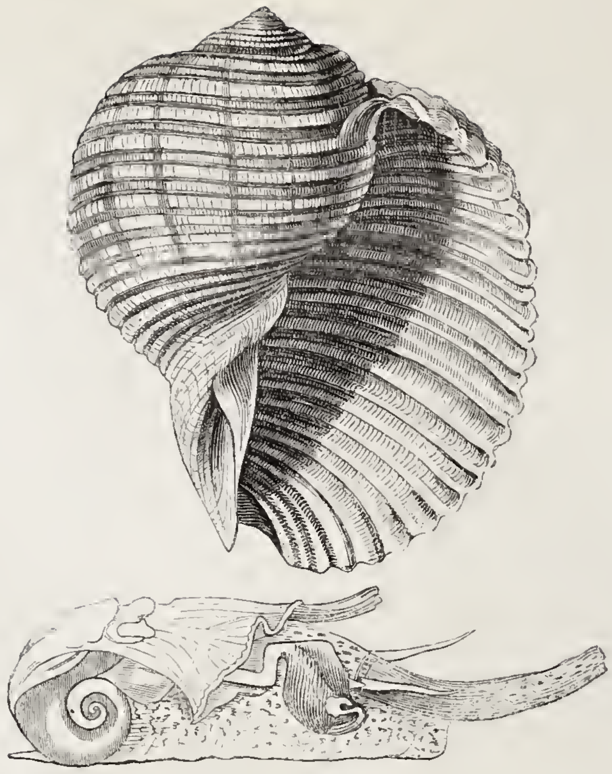


2781.—Waved Whelk.

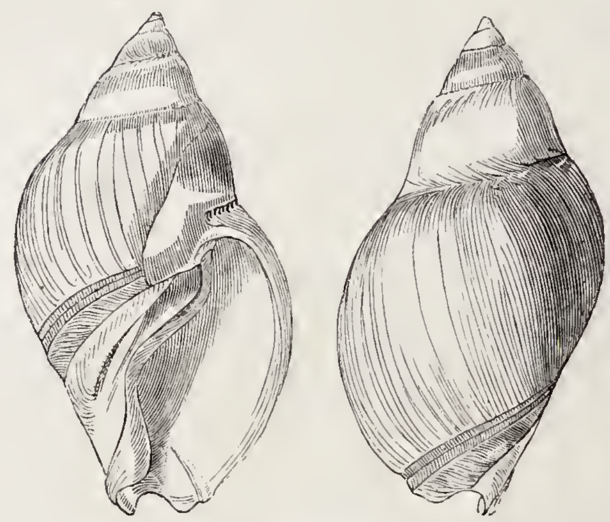
2785.—Cancellated Oniscia.



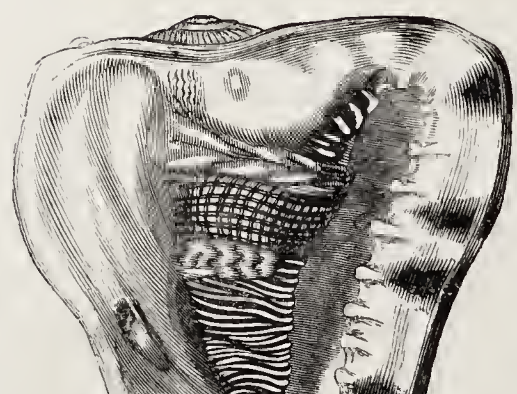
2782.—Ventricose Harp.



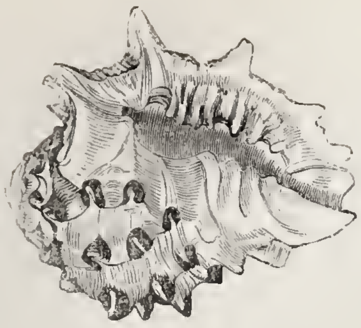
2783.—Helmet Dolium.



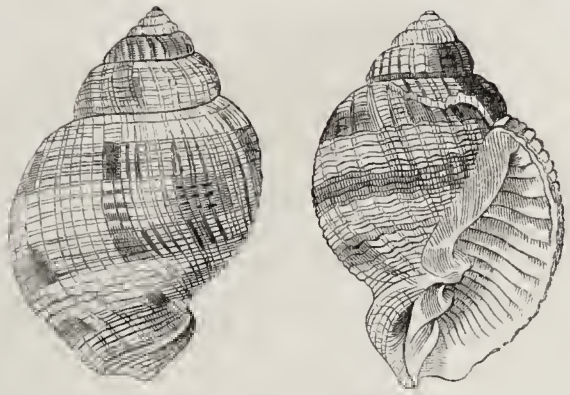
2780.—Smooth Eburna.



2786.—Tuberose Cassis, and Mollusk of C. sulcata.



2787.—Spinous Ricinula.

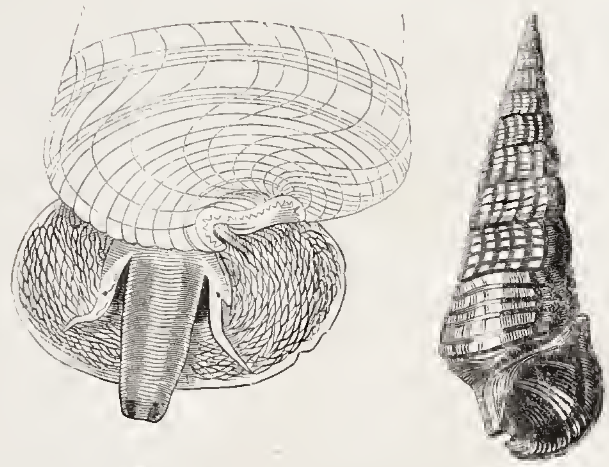


2788.—Reticulated Cancellaria.

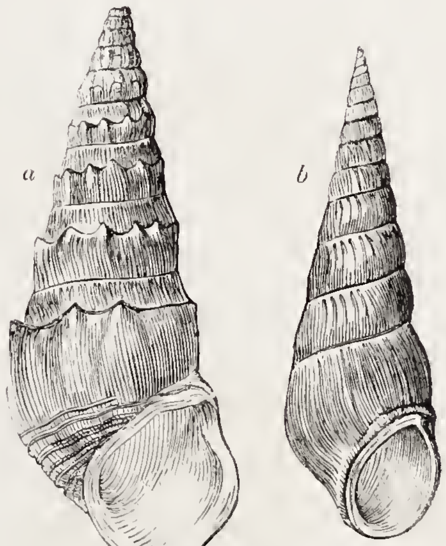
2789.—Persian Purpura.

2790.—Imbricated Purpura.

2791.—Peruvian Concholepas.



2792.—Marsh Cerithium and Animal of C. Telescopium.



2793.—Madagascar Cerithium.

2794.—Bi-carinated Trichotropis.

"The difficulty of collecting the purple juice, and the tedious complication of the dyeing process, made the purple wool of Tyre so expensive at Rome that in the time of Augustus a pound of it cost nearly 30*l.* of our money.* Notwithstanding this enormous price, such was the wealth accumulated in that capital, that many of its leading citizens decorated themselves in purple attire, till the emperors arrogated to themselves the privilege of wearing purple, and prohibited its use to every other person. This prohibition operated so much to discourage this curious art, as eventually to occasion its extinction, first in the western and then in the eastern empire, where, however, it existed in certain imperial manufactories till the eleventh century.

"Gage, Cole, Plumier, Réaumur, and Duhamel have severally made researches concerning the colouring juices of shell-fish caught on various shores of the ocean, and have succeeded in forming a purple dye, but they found it much inferior to that furnished by other means. The juice of the buccinum is at first white; it becomes by exposure to air of a yellowish green, bordering on blue; it afterwards reddens, and finally changes to a deep purple of considerable vivacity. These circumstances coincide with the minute description of the manner of catching the purple-dye shell-fish, which we possess in the work of an eye-witness, Eudocia Macrembolitissa, daughter of the Emperor Constantine VIII., who lived in the eleventh century."

Mr. W. Cole of Bristol thus describes, in 1684, the process of obtaining the dye of the Purpura lapillus:—

"The shells, being harder than most of other kinds, are to be broken with a smart stroke with a hammer, on a plate of iron or firm piece of timber (with their mouths downwards), so as not to crush the body of the fish within; the broken pieces being picked off, there will appear a white vein, lying transversely in a little furrow or cleft, next to the head of the fish, which must be digged out with the stiff point of a horsehair pencil, being made short and tapering. The letters, figures, or what else shall be made on the linen (and perhaps silk too), will presently appear of a pleasant light green colour, and, if placed in the sun, will change into the following colours, *i.e.*, if in winter, about noon; if in the summer, an hour or two after sun-rising, and so much before setting; for in the heat of the day, in summer, the colours will come on so fast, that the succession of each colour will scarcely be distinguished. Next to the first light green it will appear of a deep green, and in a few minutes change into a sea green; after which, in a few minutes more, it will alter into a watchet blue; from that, in a little time more, it will be of a purplish red; after which, lying an hour or two (supposing the sun still shining), it will be of a very deep purple red, beyond which the sun can do no more. But then the last and most beautiful colour, after washing in scalding water and soap, will (the matter being again put into the sun or wind to dry) be of a fair bright crimson, or near to the prince's colour, which afterwards, notwithstanding there is no use of any stiptic to bind the colour, will continue the same, if well ordered, as I have found in handkerchiefs that have been washed more than forty times; only it will be somewhat allayed from what it was after the first washing. While the cloth so writ upon lies in the sun, it will yield a very strong and fœtid smell, as if garlic and assafœtida were mixed together." ('Phil. Trans.,' Abr. II. 826.)

A similar scent was produced by the purple dye of the ancients.

Mr. Sowerby, in his description of a new species of Scalaria (Scalaria diadema) from the Gallapagos, says, "A fluid secreted by the animal produces a bright purple dye." (See 'Proceeds. Zool. Soc.' 1832, p. 55.)

We are now presented with a patelloid or limpet-like form, constituting the genus Concholepas, which most naturalists regard as closely allied to Purpura.

These shells, says Cuvier, have the general characters of Purpura, but their aperture is so enormous, and their spire so inconsiderable, that they have in a great degree the appearance of those of the genus Capulus, or of one of the valves of an Arca. Their notch has a little salient tooth on each side. The mollusk resembles that of the Buccini, excepting that the foot is enormously broad and thick; and that the animal is attached to the shell by a muscle in the form of a horse-shoe, as in Capulus. The operculum is horny, thin, and narrow.

Lamarck places Concholepas in the situation assigned it by Cuvier. M. Rang observes that he might have well united it to Purpura, as M. de Férussac had done, adding that M. Lesson's communication respecting the animal which he brought home from the South Sea sufficiently proves that in all essentials it agrees with Purpura, its operculum alone affording a definite character. The shell is thick, rugose, and ribbed transversely on its external surface; internally the muscular impression of a horse-shoe shape is very visible; there is no columella.

2791.—THE PERUVIAN CONCHOLEPAS

(*Concholepas Peruviana*). It would appear that this is the only ascertained species (unless indeed others have been recently found); but, according to M. Rang, it presents two distinct varieties. It is littoral in its habits, and is very abundant along the shores of Peru and Chile, often attaining to a very large size.

It is not known in a truly fossil state, but occurs, among other shells on the coast, at a considerable elevation above the sea. The beds of recent shells thus situated prove the upheaving of the line of coast, and that at no great distance of time.

Mr. Darwin, in his admirable narrative, often alludes to these beds of shells, and the geological facts which their presence tends to prove. One interesting passage is as follows:—"August 14th, I set out on a riding excursion for the purpose of geologizing the basal part of the Andes, which alone at this time of the year were not shut up by the winter's snow. Our first day's ride was northward along the sea-coast: after dark we reached the Hacienda of Quintero, the estate which formerly belonged to Lord Cochrane. My object in coming here was to see the great beds of shells which are elevated some yards above the level of the sea. They nearly all consist of one species of Erycina, and these shells at the present day live together in great numbers on the sandy flats. So wonderfully numerous are those forming the beds, that for years they have been quarried and burnt for the lime with which the large town of Valparaiso (in Chile) is supplied. As any change of level, even in this neighbourhood, has been disputed, I may add that I saw dead barnacles adhering to points of solid rock, which are now so much elevated, that even during gales of wind they would scarcely be wetted by the spray."

The configuration, in fact, of Chile, shows that it must formerly have been at a much lower level than at present, and cut up, like Tierra del Fuego, by inlets, bays, and coves, which are now valleys and ravines.

"Chile," says Mr. Darwin, "as may be seen in the maps, is a narrow strip of land between the Cordillera and the Pacific, and this strip is itself traversed by several mountain-lines, which in this part run parallel to the great range: between these outer lines and the main Cordillera a succession of level basins, generally opening into each other by narrow passages, extend far to the southward. In these the principal towns are situated, as San Felipe, Santiago, and S. Fernando. These basins or plains, together with the transverse flat valleys, like that of Quillota, which connect them with the coast, I have little doubt, are the bottoms of ancient inlets and deep bays, such as at the present day intersect every part of Tierra del Fuego and the west coast of Patagonia. Chile must formerly have resembled the latter country in the configuration of its land and water. This resemblance was occasionally seen with great force when a level fog covers, as with a mantle, all the lower parts of the country; the white vapour curling into the ravines beautifully represented little coves and bays, and here and there a solitary hillock peeping up, showed that it had formerly stood there as an islet. The contrast of these flat valleys and basins, with the irregular mountains, gave the scenery a character which to me was very novel and very interesting."

From this account it is easy to see how beds of unfossilized shells identical with living species, and among them the Concholepas, may occur considerably inland, and at a great elevation above the level of the sea. On the island of San Lorenzo (Peru) Mr. Darwin also found satisfactory proofs of elevation within a recent period. In that island extensive beds of shells exist, and he says, "When examining the beds of shells which have been raised above the level of the sea, on other parts of the coast, I have often felt curious to trace their final disappearance from decay. On the island of San Lorenzo this could be done in the most satisfactory manner. At a small height the shells were quite perfect; on a terrace eighty-five feet above the sea they were partially decomposed, and coated by a soft scaly substance; at double this altitude a thin layer of calcareous powder beneath the soil, without any trace of organic structure, was all that could be discovered. This highly curious and satisfactory gradation of change, it is evident, could be traced only under the peculiar conditions of this climate, where rain never falls so as to wash away the particles of shells in their last stage of decomposition. I was much interested by finding imbedded, together with pieces of sea-weed, in the eighty-five foot bed, a bit of *cotton thread*, plaited rush, and the head of a stalk of Indian corn: this fact, coupled with another which will be mentioned, proves, I think, the amount of eighty-five feet elevation since man inhabited this part of Peru. On the coast of Patagonia and La Plata, where, perhaps, the movements have been slower, there is evidence, as we have seen, that several mammalia have become extinct during a smaller change of level. At Valparaiso, where there exist abundant proofs of elevation to a greater altitude than in this part of Peru, I can show that the greatest possible change during the last two hundred and twenty years has not exceeded the small measure of fifteen feet."

We might enter more fully into this interesting subject; it is a digression into which, indeed, we have been led very naturally by the statement of the occurrence of the Concholepas with other shells far above the sea, but which we must not pursue too far. We close it by recommending Mr. Darwin's 'Journal of the surveying Voyages of the Adventure and the Beagle' to those desirous of further information.

A group of turriculated shells, constituting the genus Cerithium, invite attention.

Cuvier isolates this genus alike from the Buccinidæ and from the Muricidæ, placing it between these two families. The Rev. M. J. Berkeley, and Mr. Hoffman, whose dissection of the mollusk is detailed in the 'Zool. Journal,' vol. v., consider the form as intermediate between the Trochidæ and present family.

The genus Cerithium is numerous both in living and fossil species; the living species are all marine, with the exception of a few which live at the mouths of rivers, and which were separated by Brongniart into a distinct genus, Potamides, adopted by Cuvier, but which M. Rang observes cannot stand, because it is not based upon characters sufficiently decided. M. de Blainville divides Cerithium into five sections; but one of these contains the Pirena, which both M. Rang and M. de Férussac place with Melanopsis.

M. Deshayes enumerates eighty-seven species of living Cerithia, of which two or three only are European.

In the genus Cerithium the shell is turriculated, and more or less tuberculous; the aperture is small, oval, and oblique; the columellar lip very much excavated and callous; the right lip sharp; the operculum is horny, oval, and striated.

The mollusk is greatly elongated; the mantle is prolonged on the right side into a canal, but not a perfect tube; the muzzle is proboscidiform; the tentacula are distant and ringed, with a medial prominence on which the eyes are seated. The mouth is a simple terminal slit; the tongue is slender, with reflexed teeth.

2792.—THE MARSH CERITHIUM

(*Cerithium palustre*). The perfect shell belongs to this species, which tenants the salt-marshes along the coasts in the East Indies. The left-hand accompanying figure exhibits the animal of Cerithium Telescopium.

2793.—THE MADAGASCAR CERITHIUM

(*Cerithium Madagascariense*, De Blain.). Referring to the two figures, *a* represents the Cerithium Madagascariense, Lamarck; and *b*, the Cerithium Madagascariense according to De Blainville—the Pirena of Lamarck. Though these shells appear to be specifically distinct, it is possible that they may be only varieties. Our impression however is that they are distinct.

With respect to the habits of the Cerithia, Adanson, speaking of one of the species, says, that it lives in the sand amongst grass and mangroves, feeding on "scolopendres" and other small marine worms. The individual which formed one of the subjects of the investigation by Mr. Berkeley and Mr. Hoffman, and which was brought from Calcutta, though placed in fresh sea-water, the utmost care being taken to renew it frequently, and though all kinds of marine substances were supplied to the animal for food, refused all nourishment, contenting itself with simply walking over the substances, and, in so doing, touching them with its proboscis. As it would not feed, this individual was killed by immersion in spirit. The other specimen, which was anatomized by the zoologists above mentioned, was brought from Ceylon. Mr. Gray (March 25, 1834) read a note to the Zoological Society of London, giving an account of the arrival in England of two living specimens of Cerithium armatum, which had been obtained at the Mauritius, and had been brought from thence in a dry state. That the inhabitants of land-shells will remain alive without moisture for many months, is, he remarked, well known. He had occasion to observe that various marine mollusca will retain life in a state of torpidity for a considerable time; some facts, in illustration of which, he had communicated to the Society ('Zool. Proc.,' part i., p. 116). The present instance included, however, a torpidity of so long a

* Pliny says that a pound of the double-dipped Tyrian purple was sold in Rome for a hundred crowns.

continuance as to induce him to mention it particularly. The animal, though deeply contracted within the shell, was apparently healthy, and beautifully coloured. It emitted a considerable quantity of bright green fluid, which stained paper of a grass-green colour: it also coloured two or three ounces of pure water. This green solution, after standing twelve hours in a stoppered bottle, became purplish at the upper part; but the paper retained its green colour though exposed to the atmosphere. A specimen of C. Telescopium, sent from Calcutta to Mr. G. B. Sowerby in sea-water, lived out of water in a small tin box for more than a week. Cerithium has been found in the sea on various bottoms, and in estuaries, at a depth ranging from the surface to seventeen fathoms.

The communication to which Mr. Gray refers, in the 'Zool Proceeds.' Pt. I., 1833, p. 116, is as follows:—

"It is well known that the animals of terrestrial shells are torpid during the winter in cold and temperate climates, and during the dry season or summer in tropical regions; but it had not been previously remarked that a similar state occurs in those of marine shells. Mr. Gray found that many individuals of Littorina petræa, and some of Litt. rudis, were in this condition during his stay at Dawlish. They were attached to the rocks several feet above the reach of the highest autumnal tides; their foot was entirely retracted, and a membranous film was spread between the rock and the edge of the outer lip of the shell. The gills were only moist, the branchial sac being destitute of that considerable quantity of water which exists in it, in those of the same species which are adherent to the rock by their expanded foot. In this torpid condition the individuals observed by Mr. Gray continued during the whole of his stay, which lasted for more than a week. On removing several of them and placing them in sea-water, they recovered in a few minutes their full activity."

We now pass to a genus, Trichotropis, Brod. and Sowerb., the situation of which is not very clear; though in most particulars the mollusk agrees with Buccinum.

The shell has something the shape of Turbo; but is distinguished from that genus by its thinness, and from Buccinum by the want of a notch at the base of the aperture, and by the very indistinct canal. Again, from Turbo, as Mr. Broderip observes, it may be easily known by its elliptical and not spiral operculum, and by the absence of lateral ciliated membranes. It appears to be a link between Buccinum and Cancellaria, differing from the latter in being destitute of the oblique folds at the base of the columella.

The shell, which from its soft spines is very curious, may be described as turbinated and carinated externally. The aperture is wide; the whole shell thin and delicate. It is covered with a horny epidermis, forming rows of numerous sharp-pointed processes along the edges of the carinæ on the outer surface of the shell.

The operculum is horny, smaller than the aperture of the shell, and composed of elliptical laminæ.

In many particulars the mollusk resembles the Buccinum, differing principally in having a very small fold of the mantle.

The species known amount only to two, or perhaps three.

2794.—THE BI-CARINATED TRICHOTROPIS

(*Trichotropis bi-carinata*). This delicate white translucent shell has a double keel, each beset with soft spines; the epidermis is horn-colour. The letter *a* distinguishes the operculum detached.

This species is a native of the arctic seas, and has been brought from Newfoundland, and the Bay between Icy Cape and Cape Lisbon, dredged up in ten or fifteen fathoms of water. An allied species, Trichotropis borealis, is also found in the Northern Ocean near Melville Island, whence specimens were brought to England by Sir W. E. Parry. A single specimen was found at Oban in Argyleshire by the Rev. T. Lowe; and Captain Belcher procured one at Icy Cape.

Whether the Fusus 4-costatus of Say, a fossil shell of considerable size, belongs to this genus or not, is a point which Messrs. Broderip and Sowerby leave undecided. It differs materially from the two recent species in having an enormous umbilicus.

Family MURICIDÆ (MURICES, SPINDLE-SHELLS, &c.),

The Siphonostomata of M. de Blainville, which he regards as closely allied to the preceding family. In this family, says Cuvier, are comprehended those shells which have a straight projecting canal; the mollusks have all a proboscis; tentacles close together, elongated, with the eyes on the outer side. The operculum is horny; the head is destitute of a veil; they are all of carnivorous habits. The genera are numerous, and the species collectively almost endless. Of Pleurotoma thirty-six new species are characterized by Mr. Sowerby in the 'Zool. Proc.' 1833, from the western coast of South America and the islands of the South Pacific. Of Triton Messrs. Broderip and Sowerby describe sixteen new species. Of Murex twenty-three species are described by Mr. Broderip ('Zool. Proc.' 1832), to say nothing of other genera. We can attempt only a sketch of the leading forms.

In the genus Pleurotoma the shell is fusiform, slightly rugose, with a turriculated spire: the aperture is small and oval, terminated by a straight canal more or less long. The right lip is trenchant, and more or less incised.

2795.—THE TURRETED PLEUROTOMA

(*Pleurotoma Babylonica*). This species is a native of the Indian seas and the Moluccas. The shell is fusiform and turreted, transversely carinated or ridged, and belted; the whorls are convex; the canal rather long, and the right lip incised a little beyond the middle. The colour is white with black spotted belts; the spots quadrate.

2796.—THE EARED PLEUROTOMA

(*Pleurotoma auriculifera*). This species is an example of that subgeneric group in which the canal is short, and the incision of the right lip adjacent to the spire. Such shells constitute the genus Clavatula of Lamarck.

The shells of Pleurotoma occur at depths varying from six to sixteen fathoms.

The fossil species are very numerous. Deshayes enumerates one hundred and fifty in the tertiary deposits. In Europe they occur chiefly in the calcaire grossier, the London clay, the clay near Bordeaux, and the Subapennine beds.

Passing on to the genus Fusus (Spindle-shells), it may be observed that the shell is fusiform, often ventricose in the middle, rugose, and thick; the spire is very produced; the canal is straight and elongated; the aperture oval; the right lip trenchant; the columellar lip smooth; operculum horny.

Fig. 2797 represents the animal of Fusus creeping on its disc; *a*, the operculum.

2798.—THE DISTAFF FUSUS

(*Fusus colus*). This species is a native of the Indian Ocean. The shell is fusiform, narrow, and transversely furrowed; the whorls are convex, and carinated in a nodular manner in the middle. The right lip is sulcated within, and denticulate on the margin. The colour is white, passing into rufous at the apex and base.

The genus Fusus is subdivided into several sections; the fossil species are enumerated in M. Deshayes's Tables at 111, belonging to tertiary deposits; but to this number others have been added, among which we may notice sixteen described by Mr. Lee, from the tertiary beds at Claiborne, Alabama, and one from Maryland.

We now pass to the genus Pyrula. In this genus the shell is pear-shaped in consequence of the retraction of the spire; the aperture is oval and rather large; the canal conical, and variable in length; the right lip trenchant; the columella smooth and bent; operculum horny.

2799.—THE BAT-LIKE PYRULA

(*Pyrula Carnaria*). Pyrula Vespertilio, Lam.; Murex Vespertilio, Gmel.; Fusus Carnarius, Mart.

The Indian Ocean affords this pyrula, which is distinguished by the thickness of its shell, which is large and ponderous. The spire is moderately prominent; the ridge of the last whorl is crowned with compressed tubercles; the general colour is rufous bay.

2800.—THE FIG-LIKE PYRULA

(*Pyrula ficus*). This species is an example of a group included in the genus Pyrula, distinguished by ventricose form of shell; the structure, moreover, is rather delicate. In the present pyrula the shell is fig-shaped, with a short spire, and a patulous aperture, prolonged into a wide canal, the columellar lip of which is somewhat flexuous; the last whorl is ample, and transversely striated. The general colour is bluish grey, with bay or violet spots. The mouth is generally of bluish or pale violet hue. This species is found in the Indian seas; specimens have been obtained at the Moluccas. M. Deshayes in his Tables enumerates thirty-one living species of Pyrula, and twenty-one fossil forms in the tertiary deposits, of which about four are identical with existing species. Mr. Mantell records two species from the blue clay of Bracklesham in Sussex, and one from the arenaceous limestone of Bagnor. Dr. Fitton notices three from the strata below the chalk in Kent, and Mr. Lea enumerates three from the tertiary beds at Claiborne, Alabama.

From the genus Pyrula we advance to that termed Fasciolaria, distinguished by some oblique folds on the columella. The shell is of a fusiform shape, convex in the middle, with an oval aperture passing into a long and rather wide anterior canal. The right lip is trenchant, and often wrinkled internally. The operculum is horny. Fig. 2801 represents the animal of Fasciolaria: *a*, the operculum at the extremity of a short thick foot; the eyes are at the base of the tentacula; the respiratory tube is long.

2802.—THE TULIP FASCIOLARIA

(*Fasciolaria tulipa*). The shell is fusiform, ventricose in the middle, and smooth. It varies in colour, being sometimes of an orange rufous tint, sometimes marbled with white and bay, girt with transverse brown lines, unequally arranged; the outer lip is white, striated within. It is a native of the West Indian seas.

The Fasciolariæ are generally found on muddy bottoms, at depths ranging from the surface to seven fathoms.

The species of the genus Fasciolaria are less numerous than those of many others. M. Lamarck records eight living species, and M. Deshayes only seven. In the 'Proceeds. Zool. Soc.,' 1832, p. 32, Mr. Broderip describes a new species, belonging to the collection of Mr. Cuming, from Panama, viz. Fasc. granosa. With respect to fossil species, M. de Blainville states the number known as seven, but M. Deshayes enumerates only five belonging to tertiary deposits. Professor Sedgwick and Mr. Murchison record one fossil species (Fasciolaria elongata) as occurring in the Gosau deposit, and its equivalents in the eastern Alps. Mr. Lea notices two, Fasc. picta and Fasc. elevata, in the tertiary beds at Claiborne, Alabama.

We now advance to the genus Turbinella. The shell is in most species turbinated, but also sometimes turriculated, rugose, and thick; the spire is variable in form; the aperture is elongated, merging into a straight and sometimes short canal; the right lip is entire and sharp-edged; the columellar lip is covered by a broad callosity with two or three unequal and nearly transverse plaits or ridges.

This genus is divided into the following sections:

Section 1. Species fusiform and nearly smooth—Example: Turbinella Rapa.

Section 2. Species turbinaceous and spiny—Example: Turbinella Scolymus.

Section 3. Species turriculated and subfusiform—Example: Turbinella Infundibulum.

2803.—THE TURNIP TURBINELLA

(*Turbinella Rapa*). This species is an example of the first section, the shell being smooth, fusiform, and ventricose in the middle; it is thick and ponderous; the edge of the whorls is tumid, advancing over the line of demarkation. This species is a native of the Indian seas; it is found on bottoms of sandy mud at depths varying from the surface to eighteen fathoms.

The Turbinellæ are all natives of the warmer latitudes. Their number is moderate. M. Lamarck enumerates twenty-three living species; to these must be added three more described by Mr. Broderip from specimens in the collection of Mr. Cuming, and procured at the Gallapagos Islands, Elizabeth Island, and the Caraccas. M. Deshayes makes the number of existing Turbinellæ thirty-two, and that of fossil species three, recently discovered in the tertiary deposits.

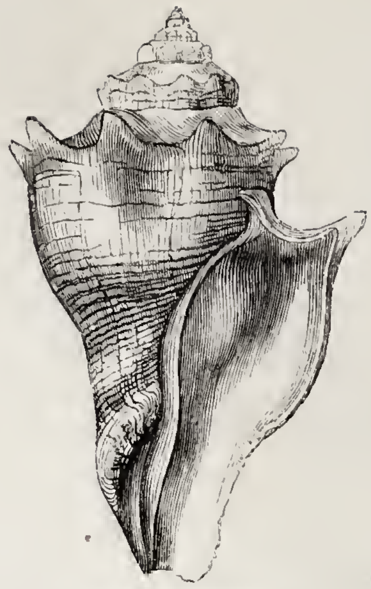
The next genus to be noticed is termed Columbella. The shell is thick, turbinated, with a short spire; the aperture is narrow and elongated, merging into a wider but short canal; the right lip has the margin thickened, and the reflex part often serrated internally; the columellar lip has a notched and thickened edge along the anterior canal. Of the mollusk itself little is known, nor is it quite clear that the genus is in its most appropriate station. One species, the Columbella avara of Say, has not, according to M. de Blainville, the right lip thickened.

2804.—THE MERCATORIAL COLUMBELLA

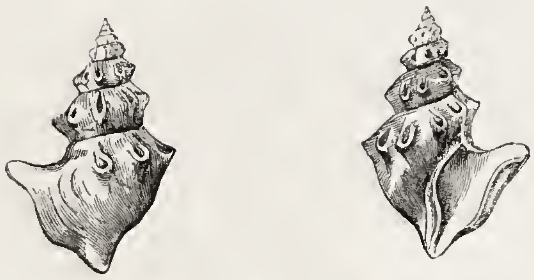
(*Columbella mercatoria*). In this species the outer lip is distinctly serrated or toothed, the external surface is transversely sulcated. It is of a white colour, with small rufous-brown transverse lines, and is sometimes banded with the same tint. It is a native of the Atlantic, and, like the Columbellæ, is generally found on bottoms of sandy mud varying in depth from the surface to sixteen fathoms.

The species of this genus are very numerous, all tenanting the seas of the warmer latitudes. M. Lamarck describes eighteen species. M. Deshayes enumerates thirty-three living species, and three fossil; and Mr. G. B. Sowerby, in the 'Proceeds. Zool. Soc.' 1832, p. 113. et seq., describes thirty-nine new species, all collected by Mr. Cuming on the western coast of South America and among the islands of the South Pacific Ocean. Of these one, the Columbella procera, is remarkable for its gigantic size. Though not precisely according with the characters of Columbella as given by Lamarck, yet,

2795.—Turreted Pleurotoma.



2799.—Bat-like Pyrula.

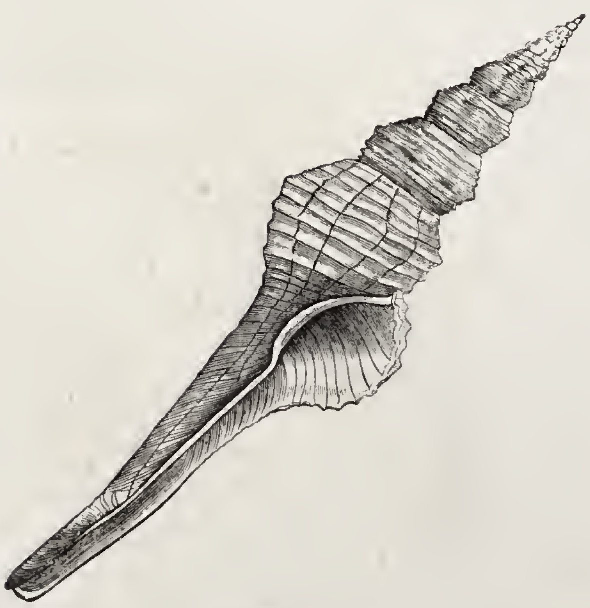


2796.—Eared Pleurotoma

2800.—Fig-like Pyrula.

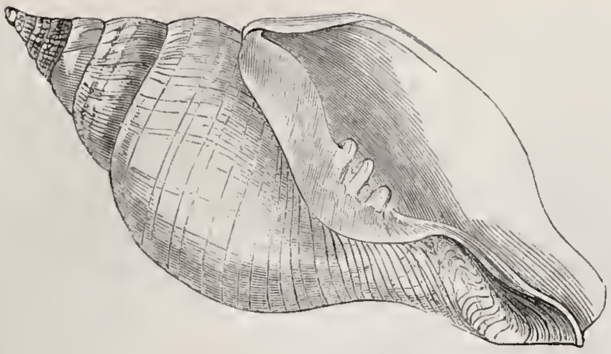
2797.—Animal of Fusus.

2801.—Animal of Fasciolaria.

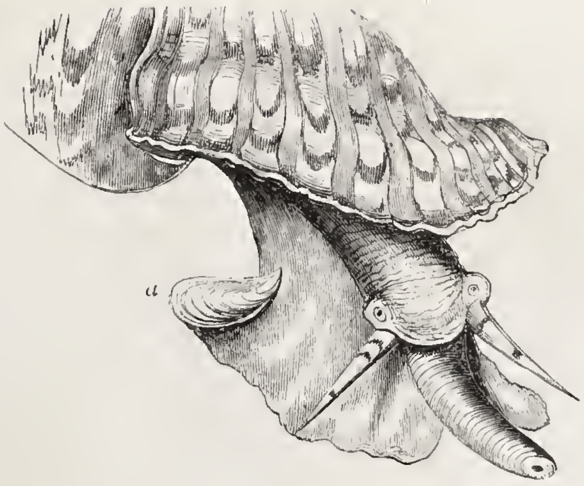


2798.—Distaff Fusus.

2802.—Tulip Fasciolaria.

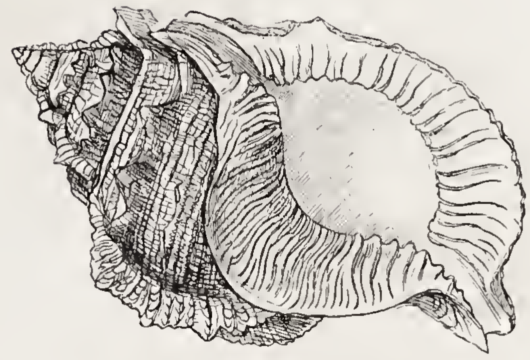


2803.—Turnip Turbinella.



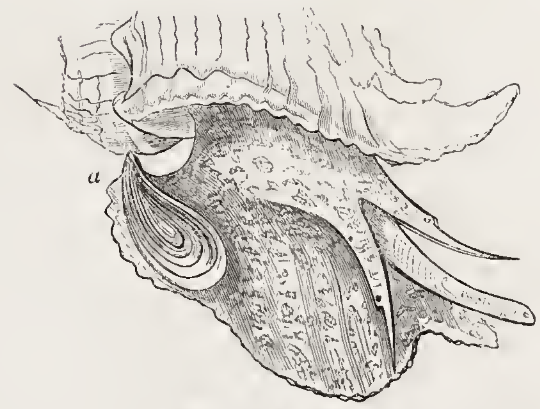
2805.—Animal of Triton.

2804.—Mercatorial Columbella.

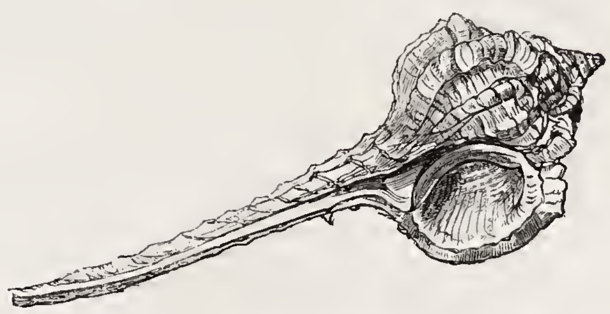


2807.—Foliated Ranella.

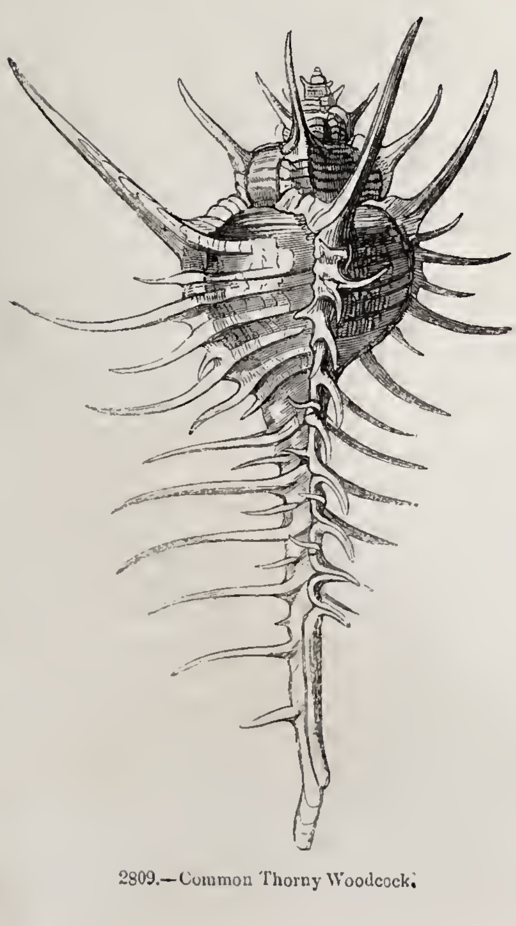
2806.—Variegated Triton.



2808.—Animal of Murex.



2810.—Woodcock's Head.



2809.—Common Thorny Woodcock.

2811.—Royal Murex.

says its describer, it must be placed with that genus, to which it is more nearly related than to any other. A single specimen only was found at Panama.

We now pass to the genus Triton. In this genus the shell is oval with the spire moderate, and the canal rather short; externally it is in general rugose, with a few varices, scattered and longitudinal in their direction. The aperture is suboval; the right lip is thickened, the columellar lip covered by a callosity. The operculum is horny, and somewhat oval or muscle-shaped. The mollusk much resembles that of Murex; the foot is thick; the eyes are placed on an elevation at the base of the taper tentacula. The tube is large. The animal of Triton is represented at Fig. 2805, *a* is the operculum.

The genus Triton is divided into several sections, as follows:—

Section 1. The species comparatively smooth, with thickened lines or ridges either very slight or wanting, excepting at the edge of the right lip. Example: Triton variegatus.

Section 2. The species more tuberculous or spiny, with the aperture more open. Example: Triton Lotorium (Genus Lotorium of De Montfort.)

Section 3. The species with a shorter spire, always very tuberculous, and most frequently umbilicated; a sinus at the posterior juncture of the two lips. Example: Triton cutaceus. (Genus Aquilus of De Montfort.)

Section 4. The species as in section 3, but with the aperture closely narrowed by a callosity and irregular teeth. Example: Triton Anus. The Grimace of collectors. (Genus Persona of De Montfort.)

The Tritons occur at depths ranging from he surface to thirty fathoms; generally on sandy or muddy bottoms.

2806.—The Variegated Triton

(*Triton variegatus*). This handsome species, commonly called the sea-trumpet, or Triton's shell, is found both in the seas of the West Indies and those of Asia, within the tropics. The shell is elongated, conical, ventricose below, and trumpet-like in general contour; it is girt with very obtuse smooth ribs. The ground colour is white, elegantly variegated with red and bay; the aperture is red; the columellar lip wrinkled with white; the edge of the outer lip is spotted with black, each black mark having two white denticulations.

The genus Triton is abundant in species. Lamarck enumerates fifty-one recent, and three fossil. M. Deshayes gives the number of living species as forty-three, and of fossil species in tertiary deposits twenty-five, of which still six exist in a living state. In the 'Proceeds. Zool. Soc.' 1833, p. 5, et seq., Mr. Broderip describes eight new species, in Mr. Cuming's collection, from the west coast of South America, and the islands of the South Pacific; and at page 71 Mr. G. B. Sowerby describes eight additional new species from the same localities.

Our next pictorial specimen constitutes an example of the genus Ranella.

The genus Ranella has the shell oval or oblong, and depressed with two varices situated laterally; the aperture is oval, the canal short, and a sinus exists at the posterior union of the two lips. It is divided into two sections, one containing the non-umbilicated species, as Ranella granulata (genus Bufo of De Montfort); the other containing the species which are umbilicated, as the Ranella foliata.

The Ranellæ tenant beds of sand, and rock, and live at depths varying from the surface to ten or twelve fathoms.

2807.—The Foliated Ranella

(*Ranella foliata*). This species, as we have said, belongs to the umbilicated section. It is a native of the seas of the Mauritius. The characters are thus detailed by Mr. Broderip. Shell ovate-conical, ventricose, not compressed, of a flesh or pale rose colour; with frequent transverse subgranulated low ridges, the interstices between which are longitudinally striated; the whorls are armed with one row of sharp tubercles, the middle ones of which are the longest; the other ridges of the body whorl are obsoletely tuberculated here and there; the columellar lip is expansive and foliated, and the margin of the outer lip expanded and thin; the aperture is ovate, very strongly and thickly furrowed, of a rich orange colour, and terminating above in a deep foliated sinus which extends beyond the varix.

The species of Ranella are rather numerous; M. Lamarck describes fifteen in a living state; M. de Blainville has described another; and Mr. Broderip has added nine, of which eight are from Mr. Cuming's collection: see 'Zool. Proceeds.' 1832. M. de Blainville enumerates only one fossil species. M. de France five; of which three from Italy are identical; M. Deshayes gives the number of fossil species as eight, of which four occur also in a living state.

We now come to the restricted genus Murex, which may be characterized as follows:—

Shell oval, more or less elevated on the spiral side or prolonged forwards. Its external surface always presents rows of spires, spines, bold processes, or tubercles arranged in regular and constant order; the aperture is oval, terminated anteriorly by a straight canal, more or less elongated and closed. The right lip is often plaited or wrinkled; the columellar lip often callous.

The mollusk has a short stout foot notched anteriorly; the head is furnished with two long approximated tentacula bearing the eyes on a thickened portion; mouth without jaws, but armed with hooked denticles in place of a tongue; mantle large, often fringed on the right side; operculum horny. Fig. 2808 represents the animal of Murex; *a* the operculum.

The genus Murex is subdivided as follows:—

Section 1. Species with a very long and spiny tube; the thorny woodcocks of collectors. Example: Murex tribulus.

Section 2. Species with a very long tube, and without spines. Example: Murex Haustellum. Woodcock's head of collectors. (Genus Brontes of De Montfort.)

Section 3. Species with three elevated, flattened, and comparatively thin varices. Example: Murex acanthopterus.

Section 4. Species with three ramified varices. Example: Murex adustus. (Genus Chicoreus of De Montfort.)

Section 5. Species which have a greater number of varices, and the tube nearly closed. Example: Murex regius.

Section 6. Species which are subturriculated. Example: Murex lyratus.

Section 7. Species which are subturriculated, the tube closed; a tube besides is pierced towards the posterior extremity of the right side, and persistent upon the whorls of the spire. Example: Murex pungens; a fossil. (Genus Typhis of De Montfort.)

Section 8. Species more globular, the spire and the canal shorter; the latter very open: the aperture rather wide.

Section 9. Species which have an oblique fold, very much anterior to the columella, and an umbilicus. (Genus Phos of De Montfort.)

The Murices are found in depths ranging from five to twenty-five fathoms; on beds of sand, mud, &c. The species are very numerous.

2809.—The Common Thorny Woodcock

(*Murex tribulus*). Murex tenuispina, Lamarck.

This species, known also by the name of Venus's Comb, is a very beautiful and striking shell, remarkable for the length and slenderness of its pointed spines; arranged in regular order, indicative of the periodical developments of the edge of the mantle. It is found in the Indian Ocean; specimens are brought from the Moluccas.

2810.—The Woodcock's Head

(*Murex Haustellum*). In this species the shell is ventricose, naked, destitute of spines, ribbed and rugose; with a long slender tube, and a short spire. The colour is fulvous, inclining to red, lineated with bay. The mouth is roundish and red. It inhabits the same seas as the preceding.

2811.—The Royal Murex

(*Murex regius*). This splendid shell is found along the western coast of Central and South America. It is one of the ornaments of the cabinet of the conchologist; nor can words convey an adequate idea of its gorgeous colouring.

In Lamarck's day, sixty-six recent species of Murex and fifteen fossil species were recorded. M. Deshayes gives the number of recent species, including those of the genus Typhis (De Montfort), as seventy-five, but this is very far below the mark; he enumerates eighty-nine fossil species in the tertiary deposits.

Mr. Broderip, in the 'Proceeds. Zool. Soc.,' describes twenty-six new species of Murex from the western coast of South America, and the islands of the South Pacific, and also five species of Typhis, all in the collection of Mr. Cuming.

The Muricidæ (Siphonostomata, De Blainville), and the Buccinidæ (Entomostomata, De Blainville), appear to be the two principal groups of marine gastropods (or trachelipods,* as some prefer to term them) destined to keep down the overabundance of the bivalve mollusks and herbivorous gastropods; they are the destroyers among the races of their class and prowl about in quest of prey. They drill the shells which enclose their victim, and drain out its juices, adhering till it is almost utterly consumed. Nor is this destruction carried forward on a limited scale. When we consider the number of species included within the two families in question, and the countless thousands of individuals of each of these species, and reflect upon their voracity, we may form some slight idea of the extent of their operations, and of the consequent influence they must exert, in maintaining the balance of creation. Throughout all seas are these carnivorous mollusks carrying on their appointed work: in ministering to their own necessities, they fulfil the great part in the vast scheme of creation to which they are appointed. We have now before us a miscellaneous assemblage of shells picked up upon our own shores, and few are undrilled; some of these carnivora have battened on their tenants, and the waves have washed them on the beach. In other ages, as we have abundant proofs, the plan of destruction, in order to counterbalance increase among these marine shell-clad mollusks, was in operation. Dr. Buckland, in his admirable 'Bridgewater Treatise,' gives the following details connected with fossil shells, once the living inhabitants of other seas, when the surface of our planet exhibited a different arrangement of land and water.

"Most collectors," says the Professor, "have seen upon the sea-shore numbers of dead shells, in which small circular holes have been bored by the predaceous tribes, for the purpose of feeding upon the bodies of the animals contained within them; similar holes occur in many fossil shells of the tertiary strata, wherein the shells of carnivorous trachelipods also abound; but perforations of this kind are extremely rare in the fossil shells of any older formation. In the green-sand and oolite they have been noticed only in those few cases where they are accompanied by the shells of equally rare carnivorous mollusks; and in the lias and strata below it,* there are neither perforations, nor any shells having the notched mouth peculiar to perforating carnivorous species. It should seem from these facts that, in the economy of submarine life, the great family of carnivorous trachelipods performed the same necessary office during the tertiary period which is allotted to them in the present ocean. We have further evidence to show that in times anterior to and during the deposition of the chalk, the same important functions were consigned to other carnivorous mollusks, viz. the testaceous cephalopods: these are of comparatively rare occurrence in the tertiary strata and in our modern seas; but throughout the secondary and transition formations, where carnivorous trachelipods are either wholly wanting or extremely scarce, we find abundant remains of carnivorous cephalopods, consisting of the chambered shells of nautili and ammonites, and many kindred extinct genera of polythalamous shells of extraordinary beauty. The molluscous inhabitants of all these chambered shells probably possessed the voracious habits of the modern cuttle-fish; and by feeding like them upon young testacea and crustacea, restricted the excessive increase of animal life at the bottom of the more ancient seas. Their sudden and nearly total disappearance at the commencement of the tertiary era would have caused a blank in the 'police of nature,' allowing the herbivorous tribes to increase to an excess that would ultimately have been destructive of marine vegetation, as well as of themselves, had they not been replaced by a different order of carnivorous creatures, destined to perform in another manner the office which the inhabitants of the ammonites and various extinct genera of chambered shells then ceased to discharge. From that time onwards we have evidence of the abundance of carnivorous trachelipods, and we see good reason to adopt the conclusion of Mr. Dillwyn, that in the formation above the chalk the vast and sudden decrease of one predaceous tribe has been provided for by the creation of many new genera and species possessed of similar appetencies, and yet formed for obtaining their prey by habits entirely different from those of the cephalopods. The design of the Creator seems at all times to have been to fill the waters of the seas and cover the surface of the earth with the greatest possible amount of organised beings enjoying life; and the same expedient of adapting the vegetable kingdom to become the basis of the life of animals, and of multiplying largely the amount of animal existence by the addition of carnivora to the herbivora, appears to have prevailed from the first commencement of organic life to the present hour." ('Bridgewater Treatise.')

Family STROMBIDÆ (STROMBUS, PTEROCERAS, &c.).

This family constitutes the Angyostomata of De Blainville. In this family is comprehended the shells which, says Cuvier, have the canal straight, or bent to the right, and the outer lip of the aperture dilated with age, but always preserving a sinus towards the canal, under which passes the head when the animal extends itself. Most have this sinus at some distance from the canal.

* Trachelipod, from τράχηλος, the neck; and πούς, ποδός, a foot; the foot in these mollusks appearing as if under the head and neck.

* Carnivorous gastropods occur in the Silurian rocks.

Cuvier, following Lamarck, divides the Strombidæ into three principal genera: Strombus proper, Pteroceras, and Rostellaria.

In Strombus proper the outer lip dilates into a wing, more or less extensive, but not divided into digitations. The foot is proportionally small, and the tentacles carry the eyes on a lateral peduncle, thicker than the tentacle itself. The operculum is horny, long, and narrow, and carried on a slender tail.

In Pteroceras the wing, or dilated outer lip, is divided in the adult into long and slender digitations, according to the species. The animal is the same as that of Strombus.

In Rostellaria, the sinus of the external edge is contiguous to the canal, and there is generally a second canal, reascending along the spire, and formed by the external lip, and by a corresponding continuation of the columella.

Fig. 2812 represents a species of Strombus (Pteroceras lambis), extricated from the shell and dissected (female): *a*, the foot seen at its anterior part with its groove; *b*, the operculum fixed at its posterior division; *c*, the ocular peduncles or tubes with the slender tentacles; *d*, the proboscis open to show the tongue; *e*, the cerebral ganglion, behind which are two long salivary glands; *f*, the œsophagus entering a large stomach; *g*, the stomach partially opened, and showing the entrance of the œsophagus; *h*, the intestinal canal; *i*, *k*, *l*, and *m*, other internal organs; *n*, the respiratory siphon; *o*, the large branchia with its vein which goes to the heart; *p*, small and rudimentary branchia; *q*, the heart; *r*, the liver.

2813.—THE BROAD-WINGED STROMBUS

(*Strombus latissimus*). As an example of the genus Strombus we select this remarkable species, which is by no means common. It is a native of the Indian seas, and grows to a large size, often measuring from eight to twelve inches in length. The shell is turbinated and ventricose, smooth on the back, but somewhat wrinkled on the wing; the spire is short; the wing or external lip very broad, rounded above, and extending beyond the spire. It is very thick, but becomes thinner at the margin, which is sharp anteriorly. The general colour is orange-brown variegated with white; the aperture is smooth and white with a roseate tinge: *a* represents the shell seen from above; *b*, the same seen from below.

2814.—THE SCORPION PTEROCERAS

(*Pteroceras Scorpius*). The shell in this species is somewhat oval, tuberculate, and transversely rugose. The outer lip or wing is divided into seven slender knotted or curled digitations, of which those in the centre are the shortest. The general colour is white spotted with rufous; the aperture is violaceous red, with the rugæ white.

2815.—THE CHINESE SPINDLE

(*Rostellaria rectirostris*). In some species of the genus Rostellaria the outer lip is digitated, as in Rostellaria Pes Pelicani, the type of the genus Aporrhais of some authors; some have dentilations only on the edge, with a straight canal; others, constituting the genus Hippocrenes of De Montfort, have the external lip dilated, but not dentilated.

The present species has the lip dentilated.

The Chinese spindle is a rare shell, and specimens with the long slender beak unmutilated are seldom to be met with in collections. A specimen exists in the British Museum in which this part is perfect, or nearly so, and recurved.

The shell is fusiform, with an acute apex; the whorls are rather convex. In young specimens the dentilations of the outer lip are either wanting or very small. The lip terminates in an elegant canal or volute at the bottom of the spire, and is indicated at the letters *a*, *a*. General colour brown; darker on the inside of the outer lip. It is a native of the Indian seas, and has been dredged up in the Straits of Macassar.

The Strombidæ are carnivorous in their habits, and tenant the seas of the hotter latitudes; many are Indian, some are found at the equator. Two species of Rostellaria, viz., R. Pes Pelicani, and R. Pes Carbonis, are natives of the Mediterranean and other European seas.

The number of species is very considerable; and many, as the huge Strombus Gigas of the West Indies, attain to enormous dimensions.

It is a curious circumstance that in several of the Strombidæ pearls have occasionally been discovered, and also, it may be added, in some others of the turbinated testaceans. We need scarcely observe that pearls consist essentially of the same material as the substance called nacre, or mother-of-pearl, with which the shell is lined. In pearls this nacre is found to be deposited in concentric layers round some minute extraneous substance, irritating the mollusk; such at least is generally the case.

Mr. Wood, in his 'Zoography,' informs us that he saw a pearl of a pink colour, taken from the body of the mollusk of a Strombus Gigas, dredged up near the island of Barbadoes, where this species of "shell-fish" is served up at table. Its weight was twenty-four grains, but unfortunately it was not perfectly round, a circumstance which rendered it less valuable. Though thousands of "shell-fish" are annually brought to the market in that part of the world, yet Mr. Wood states that he was acquainted with only four instances of pearls being found, not, as he supposes, because they are really scarce, but because the negroes who clean the fish, do not take any trouble to look for them, but perform their work without consideration; hence, as he has reason to believe, many pearls with the refuse of the fish are thrown back into the sea. With respect to the genus Strombus, M. de Blainville enumerates fifty-two recent species; the Strombus Gigas occurring also in a fossil state in tertiary deposits, but of the genera Pteroceras and Rostellaria the numbers are limited.

The fossil species of Strombidæ are not met with so frequently as those of other groups. M. Deshayes gives the number of Strombi as nine, including the Strombus Gigas. Of the Rostellariæ M. Deshayes records eight species in the tertiary strata. Mr. Lea describes two species from the Claiborne beds, Alabama: Dr. Mantell one species from the sandstone of Bognor, and two species from the Thanklin sand. Dr. Fitton (see his 'Strata below the Chalk') also enumerates some species.

ORDER TUBULIBRANCHIATA (CUV.).

CUVIER considers that the Tubulibranchiata, although they are closely related to the Pectinibranchiata, ought to be separated from the latter, because their shell, being in the form of a tube, more or less irregular (the commencement of which alone is spiral), is firmly attached to other bodies; from which cause, when once fixed, they have no power of shifting their station; hence are they necessarily bisexual, each individual continuing the race.

He divides this order into three genera, Vermetus, Magilus, and Siliquaria.

With respect to Magilus, it was placed by Lamarck among the Annelids, in the family Serpulacea; but M. de Blainville appreciated its relationship to Siliquaria and Vermetus, between which it is placed by Cuvier.

M. Rang states that when he was seeking the animal in India, he was struck with the analogy which the genus presents, not only to Vermetus, but also to some of the Pectinibranchiata; an analogy, as he observes, the more remarkable when a young individual, the shell of which has not yet become tubular, is examined.

The young shell of Magilus is, in fact, very similar to that of Leptoconchus striatus, which, as we have previously said, becomes imbedded in masses of coral or madrepore (Meandrina, &c.), in which Magilus also occurs; and Dr. Rüppell suspects that M. Rang might have mistaken the Leptoconchus for the young of Magilus. Between these shells there are, he adds, certain clear distinctions. In Leptoconchus the margins of the shell are always disunited, the contrary in Magilus; the latter has an operculum, the former has none. The proboscis, moreover, in both is different, and the mollusk of Magilus has a siphon, which is not present in Leptoconchus. Both tenant the masses of Meandrina in the Red Sea. (See 'Proceeds. Zool. Soc.' 1834, and 'Trans. Z. S.' vol. i.)

2816.—THE MAGILUS

(*Magilus antiquus*). The Magilus is here represented in its young condition, before the evolution of the tube.

2817.—THE MAGILUS

(*Magilus antiquus*). In this specimen the long sinuous tube indicative of age is very remarkable. We shall proceed to explain the manner in which this development takes place, and which is very interesting. First let us refer to the young shell (Fig. 2816); we find it of a delicate fragile structure, covered with a thin epidermis, of a ventricose figure, with a short spire of three or four turns, and a patulous aperture, the lip being produced anteriorly so as to form an angle. It is in this stage a regular spiral univalve. We must now suppose the young Magilus to have taken up its abode in some recess or fissure of the madrepore, itself in a state of growth, from the secretion of the living polypes. With the increase of the madrepore, in order that it may not be blocked up, and so destroyed, it has to put some plan in operation so as to preserve its aperture on a level with the surrounding mass, thereby securing free admission to the water. The plan dictated by instinct, for it cannot shift its quarters, is to add to the margins of its shell, building up layer after layer, according to the growth of the madrepore, and in that direction which circumstances may determine, and which will consequently vary. In proportion as the mollusk adds to the tube, so it advances forwards from the spiral shell, which it quits, filling it up with compact calcareous matter, almost crystalline in structure, and resides in the tube; and, as this continues to be lengthened, so does the animal continue to advance, filling up the unoccupied space behind with the same material. Thus, then, as necessity requires, the mollusk of the magilus carries out its tube, to which the operculum is so adapted as to act as a barrier against the assaults of enemies, a protection the more necessary as it cannot change its position. It would appear that only one species is recognised, viz., Magilus antiquus: it is of a whitish colour.

We now turn to the genus Vermetus.

Let our reader fancy a group of serpentiform tubes, all intertwined together, such as poets describe the hair of Medusa, covering old shells or stones, and he will have a good idea of the Vermeti. Such a group is represented at Fig. 2818, in which several species are depicted, like a knot of snakes, coiled in fantastic wreaths, but elevated on their tails, and dancing to the music of the charmer, who had

> "Then framed a spell when the work was done,
> And changed the '*living*' wreaths to stone."

The Vermeti, says Cuvier, have a tubular shell, of which the whorls at an early period form a sort of spiral shell, but which afterwards become prolonged into a tube more or less irregular, or twisted like the tubes of Serpulæ (certain annelids). This contorted shell is usually fixed by being intertwined with others of the same species, or in consequence of being partially enveloped by lithophytes. The mollusk never creeps, and therefore has no foot properly so called; but that part which in ordinary gastropods may be called the tail, is doubled underneath, advancing before the head, and having its extremity dilated and furnished with a slender operculum. When the animal withdraws itself this mass closes the orifice of the tube: it has sometimes peculiar appendages, and in some species the operculum is spiny. The head is obtuse, with two moderate tentacles bearing the eyes at the outer side of their base; the mouth is a vertical orifice, beneath which, on each side, appears a filament having all the appearance of a tentacle, but which in reality belongs to the foot. The branchiæ form only a row along the left side of the respiratory cavity.

The species are rather numerous, but not very distinct. Linnæus, guided by the form of the shells, placed the Vermeti with the Serpulæ; and the Vermiliæ of M. Lamarck, which are identical with the Vermeti, are left by that naturalist in the situation assigned by Linnæus. Such are the Serpula lumbricalis, Linnæus, and the Serpula triquetra, with several others.

As in the genus Magilus, the mollusk gradually advances as it adds to its tube, so as to occupy the more anterior portion only.

In general the eggs of these mollusks become fixed about the spot where they are exuded; hence we may easily understand how it happens that the shells are generally found in groups; yet single isolated specimens are not uncommon, the agitation of the waves having scattered the eggs asunder, and kept them suspended till at length they become fixed upon a suitable basis. Some species, as Vermetus lumbricalis, have the commencement of a spire, the whorls of which rise perpendicularly; others take a horizontal direction with the orifice only elevated.

2819.—THE DENTILATED VERMETUS

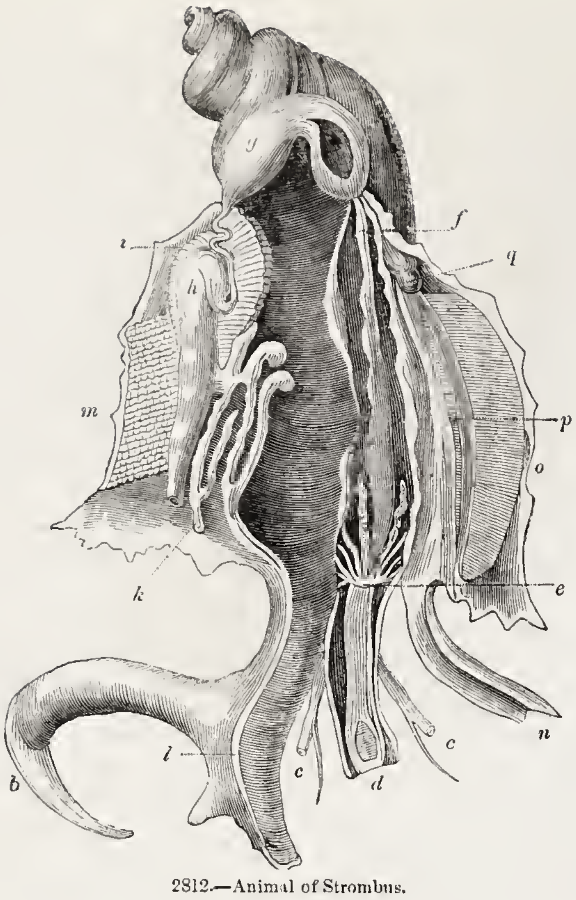
(*Vermetus dentiferus*). This species was procured by MM. Quoy and Gaimard during the voyage of the Astrolabe. *a* is the shell; *b*, the mollusk. It occurs on shells along the coast of New Holland, in Shark's Bay, &c.

2820.—THE LUMBRICOÏD VERMETUS

(*Vermetus lumbricalis*). It is this species of which a group, fixed on a shell, is represented at Fig. 2818; and, from the varied contortions and interlacings of the individuals, most picturesque is their general aspect. A similar group in the British Museum has often arrested our attention.

We now turn to the genus Siliquaria.

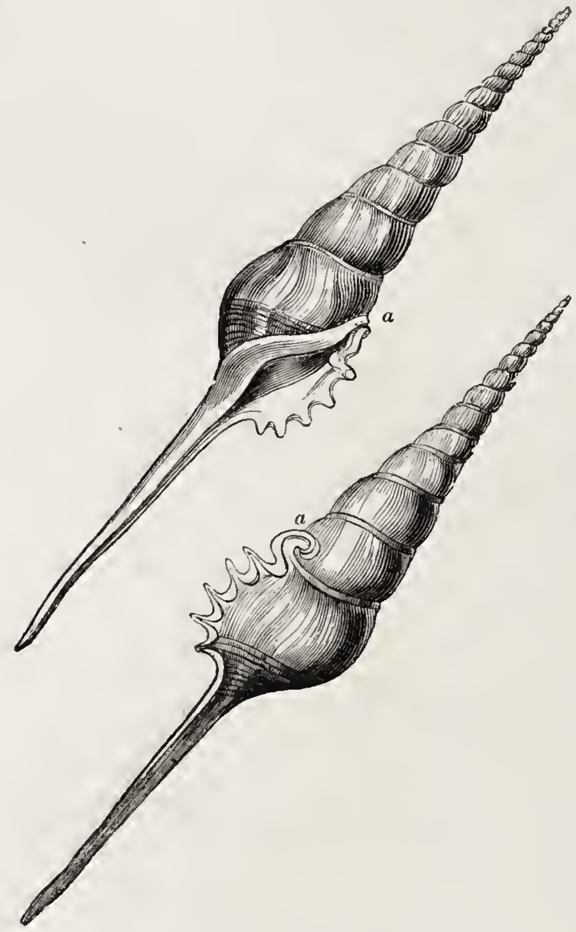
The Siliquariæ resemble the Vermeti in the general aspect of the mollusk, in the form of its head, in the position of the operculum, and in the tubular and irregular structure of the shell. There is, however, this remarkable distinction—the shell presents a slit or unfilled line throughout its whole, following the direction of its flexures, and which corresponds to a similar fissure in that part of the mantle which covers the branchial cavity; along one side of this fissure of the mantle runs the



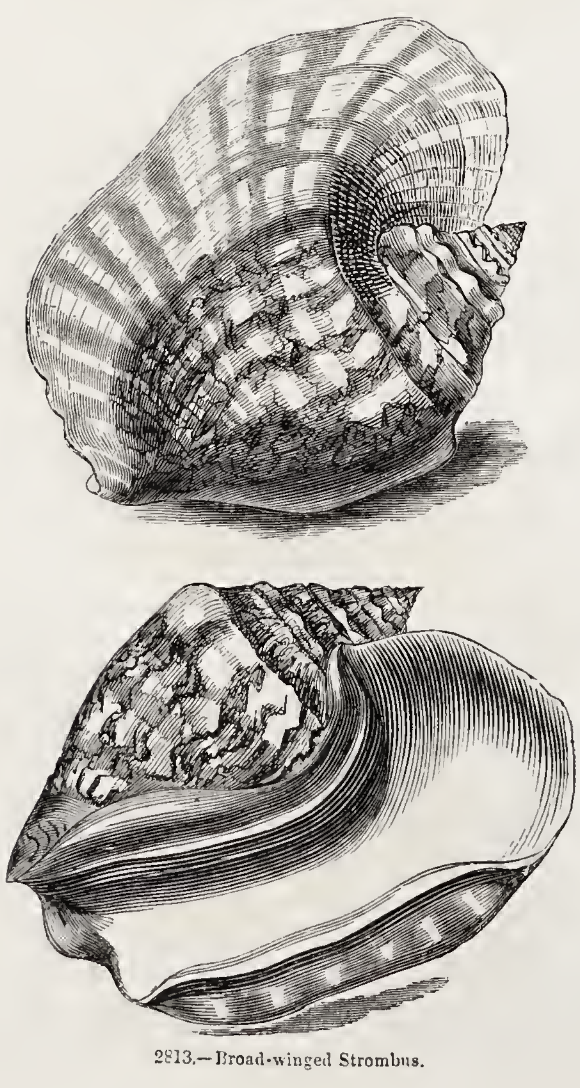
2812.—Animal of Strombus.


2814.—Scorpion Pteroceras.

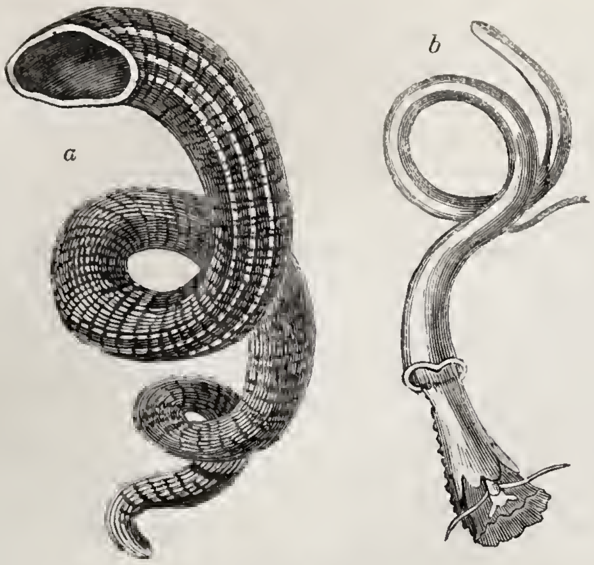

2816.—Magilus: Young.



2815.—Chinese Spindle.


2813.—Broad-winged Strombus.

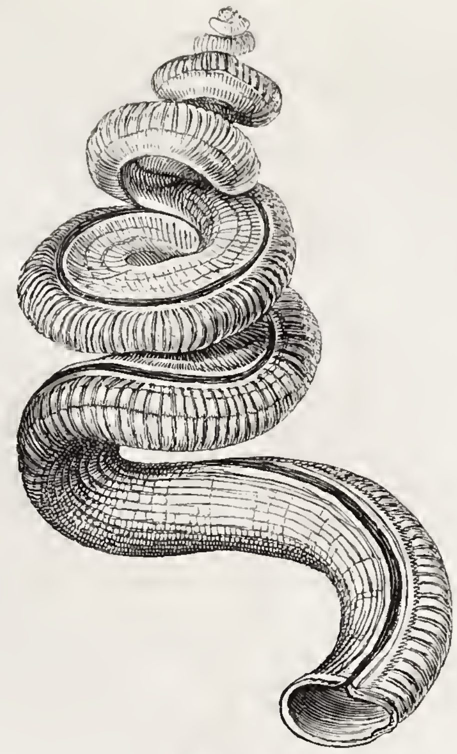

2817.—Magilus.



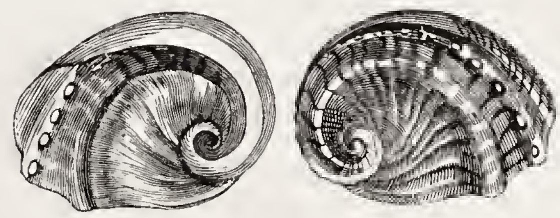
2819.—Dentilated Vermetus.

2820.—Lumbricoid Vermetus.

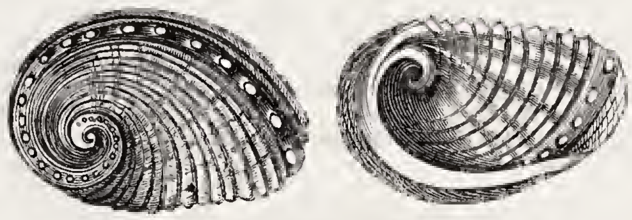
2818.—Group of Vermeti.



2821.—Muricated Siliquaria.



2824.—Ruddy Haliotis.



2823.—Ribbed Sea-Ear.

2822.—Tuberculated Sea-Ear.

branchial pectination, composed of a number of slender and tubular foliations. Linnæus placed these animals with the Serpulæ; and even in more recent days they have been regarded as belonging to the Annelids.

2821.—THE MURICATED SILIQUARIA

(*Siliquaria muricata*). This beautiful species is a native of the Indian seas.

M. Milne Edwards, who refers to the labours of M. Audouin and M. de Blainville on the Siliquariæ, observes that these animals were first distinguished by Guettard under the name of Tenagode, and that till lately they were considered as belonging to the Annelids, and closely related to the Serpulæ. This, he adds, is not their true situation; they should, in fact, be placed near the Vermeti, from the conformation of their tubiform shell. Indeed M. Savigny had been led to suspect that their affinities to the Serpulæ were by no means so immediate as had been imagined; and M. de Blainville, advancing still farther, recognised in these animals all the leading and essential characters of the true mollusks—an opinion the truth of which subsequent investigations have amply confirmed.

M. Audouin, to whom Cuvier acknowledges himself indebted for the account which he gives of Siliquaria in the 'Règne Animal,' and who had the opportunity of investigating the structure of one of these mollusks, has demonstrated their affinity to the Vermeti, which indeed might be presumed from the characters of the spirally-contorted shell, notwithstanding the fissure which interrupts the completion of the tube. The shell, when recent, is covered with a sort of epidermis, and it is adherent, by its walls, to foreign bodies, much in the manner of the annelidous Serpulæ, but less firmly.

Both Vermetus and Siliquaria occur in a fossil state. Of the former, M. Deshayes records eight living; to which must be added Vermetus dentiferus, Vermetus Zelandicus, Vermetus giganteus, Vermetus carinarius, and Vermetus roseus, described by MM. Quoy and Gaimard ('Zoology of the Astrolabe'). They occur at various depths from the surface to twelve fathoms, in sponges, under stones, on shells, and in masses of coral.

Of the fossil Vermeti M. Deshayes records one species from the tertiary deposits at Angers. The form, however, occurs below the chalk. Dr. Fitton enumerates six species from the upper green-sand, the gault, the lower green-sand, Blackdown, and the Hastings sand. With respect to Siliquaria, in the last edition of Lamarck's 'Animaux sans Vertèbres,' six recent species are enumerated, and four fossil; of which one, the Siliquaria anguina (Serpula anguina, Linn.), is found both in a recent and fossil state.

Mr. Lea records a species, the Siliquaria Claibornensis, from the tertiary of Alabama.

Some species of recent Siliquariæ have been found imbedded in sponges.

ORDER SCUTIBRANCHIATA.

THE order Scutibranchiata, in Cuvier's system, comprehends a certain number of gastropodous mollusks, exhibiting a tolerably near approximation to the Pectinibranchiata in the form and position of the branchiæ, and also in the general contour of the body, but which are bisexual, each individual continuing the species. The shells are very open, destitute of operculum, and the greater number not at all turbinated, so that they cover these animals, and particularly their branchiæ, in the manner of a buckler. In the structure of the heart, which is traversed by a portion of the intestinal tube, they resemble the majority of bivalve mollusks.

Family HALIOTIDÆ, or SEA EARS (Les Ormiers of the French).

The Haliotidæ constitute the only group of the present order in which the shell presents turbinations. The spire, however, is very compressed and small; the mouth excessively ample, and the whole contour flattened. This form has caused the Haliotis to be compared to the ear of a quadruped, and given origin to the title.

In the genus Haliotis the shell is wonderfully brilliant, with the most beautiful iridescent hues, resulting from its nacreous composition. Mingled tints of purple, red, blue, and green, interchanging in various lights, produce an admirable effect. The general form of this splendid shell is oval, more or less depressed, with a small spire, having a lateral aspect posteriorly; the aperture is as large as the shell, with a continuous border; the right border is delicate; the left or columellar border is flattened, enlarged, and trenchant; along this border is a series of orifices, in lineal order, as if drilled in the shell. Muscular impression single, and oval in the centre of the under side.

The animal is one of the most ornamented of the gastropods. All round its foot, and even over the mouth, there runs, at least in the more common species, a double membrane, fringed as it were with elegant foliations, and furnished besides with a double row of filaments. The tentacles are long, and on the outside of each is a cylindrical peduncle, on which the eyes are respectively placed. The mantle is deeply fissured on the right side; and the water which is admitted through the holes of the shell can, through this fissure, penetrate into the branchial cavity. Along its edges there are, moreover, three or four filaments, which the animal is capable of protruding through these holes. The mouth is a short proboscis.

Cuvier observes that Montfort has separated from Haliotis, into a distinct genus termed Padollus, such species as have the shell nearly circular, almost all the holes obliterated, and present a deep furrow, which is continued along the central part of the whorls, following their direction, and is bounded externally by an elevated ridge.

This genus, Padollus, was admitted by Dr. Leach, but is rejected by Mr. G. B. Sowerby, who, in his 'Genera of Recent and Fossil Shells,' observes that, with the exception of a few species which are commonly known by collectors as Imperforate Ear Shells, the genus Haliotis has suffered no dismemberments. An attempt indeed, he adds, "has been made by Montfort to separate from the genuine Haliotides two or three species under the name of Padollus, in which he has been followed by Leach; but as far as respects general adoption this attempt appears to have been as unsuccessful as it was unnecessary. Not so the separation of the Imperforate Haliotides, which are so easily distinguished by wanting the row of perforations so very characteristic of the true Haliotis." These imperforate Sea Ears form the genus Stomatia of Lamarck. The shell is hollower, the spire more elevated, and the row of orifices is wanting. In other respects they resemble the Haliotides, which, says Cuvier, they connect to certain forms of Turbo. Their mollusk is much less ornamented than that of Haliotis.

The Haliotides are marine, and littoral in their habits. Covered with their buckler-like shield, and destitute of an operculum, they adhere by their foot-like limpets to the surface of the rocks, near the water's edge, where they creep about, feeding on herbage, which, according to Lamarck, they seek for, during fine summer nights, along the margin of the shore.

If we except the colder latitudes, the genus Haliotis is distributed through all seas; the largest, however, are natives of the hotter regions. Of these some are nearly as large as a plate, and are absolutely dazzling from the splendid iridescence of their nacre. One species, the Haliotis tuberculata, is common on the coasts of Southern Europe, and was known to the ancients: it is found in tolerable abundance round the coasts of Guernsey and Jersey, and empty shells are occasionally washed upon the southern shores of our island (and more particularly the coast of Devonshire) after violent storms. Yet Mr. Sowerby is of opinion that it cannot be considered in the light of a native of those shores, though it is, doubtless, of the coasts of France, Spain, Italy, &c.

2822.—THE TUBERCULATED SEA-EAR

(*Haliotis tuberculata*). The animal is represented crawling, with its shell uppermost, at *a*; the interior of the shell is represented at *b*.

This species, which, as we have said, is common at Guernsey and Jersey, is used as food; and probably the other species are equally palatable. A learned writer, who assures us that, as an article of food, this genus is by no means to be despised, adds—"We have eaten Haliotis tuberculata, and when served by a good cook it is tender and sapid. The large fleshy foot, if not properly managed, is apt to be tough." He further informs us that "the people of Guernsey and Jersey ornament their houses with the shells of this species, disposing them frequently in quincunx order, and placing them so that their bright interior may catch the rays of the sun. We have often thought that some of the large and splendid intertropical species, whose exterior, after removing the outer coat, take a polish almost equal to the natural brilliancy of the inside, might be converted into dishes for holding fruit: if mounted with good taste, their indescribable iridescence would materially add to the richness of an elegant table."

2823.—THE RIBBED SEA-EAR

(*Haliotis costata*). This species is an example of another form of Haliotis, in which the surface is covered with ribs and intervening furrows, following the tournure of the shell. The outer lip is slightly denticulated.

2824.—THE RUDDY HALIOTIS

(*Haliotis rubicunda*). Padollus rubicundus, Montf. We have already alluded to the genus Padollus, characterized by Montfort, but not admitted by Sowerby.

In the appendix to the 'Narrative of the Survey of the Intertropical and Western Coasts of Australia, performed between the years 1818 and 1822, by Capt. Philip Parker King, R.N.,' Mr. Gray describes this species, which he regards as the Padollus rubicundus of De Montfort, Padollus scalaris of Leach, and Haliotis tricostalis of Lamarck. This beautiful and large specimen, which measures three inches and a half by two and a half, was brought to England by Captain King, who procured it upon Rottnest Island, on the West Coast of Australia. The three anterior holes only are open, but these, as well as the others which are closed, are highly elevated, as is also the ridge following the tournure of the whorls on the upper surface.

Lamarck says that the Haliotis tricostalis is a native of the seas of Java, and gives M. Leschenault as his authority.

With respect to Stomatia, it differs, as we have already said, from Haliotis. The shell presents two muscular impressions internally, seldom distinct, nearly marginal, and in the open part of the shell.

The Stomatiæ are natives of the East Indian seas, and those of New Holland. They have been found at a depth of seven fathoms, adhering to corals.

It is very doubtful whether any fossil species of Haliotis has been discovered: (Mr. Sowerby observes that he has seen incrustations taken up from the sea near the Cape of Good Hope, approximating to this form) M. Rang, however, says, we possess one or two in a fossil state; and M. Deshayes records the Haliotis tuberculata as both living and fossil from Sicily. Cuvier in a note ('Règne Animal,' vol. iii. p. 11) says, "This genus (Haliotis) although the fact has been contested, has certainly its analogue among fossils. M. Marcel de Serres has described one species found in the calcaire of Montpellier, viz. Haliotis Philberti. (Ann. des Sc. Nat. t. xii. p. xlv. f. A.)"

Family FISSURELLIDÆ (FISSURELLA, EMARGINULA, &c.).

M. de Blainville has constituted an order termed Cervicobranchiata, for the reception of the limpets, which form his family Retifera, and for the Fissurellæ, Emarginulæ, &c., forming his family Branchifera.

Cuvier observes that the genera Fissurella, Emarginula, &c., which have usually been joined to the limpets, belong to the Scutibranchiata. Dismembered from the Patellæ, he says, they have the shell altogether symmetrical, as well as the position of the heart and branchiæ.

The branchiæ are two in number, large, equal, and pectinated. They are in a large cavity, to which leads an opening, pierced at the apex of the shell, or a fissure at the anterior part of the shell, admitting the efflux of the water received through an anterior orifice.

This will be more clearly understood by the descriptions of the genera in detail, and first that termed Fissurella.

The mollusk of Fissurella is furnished with a large fleshy disc underneath, as in the limpet; a conical shell placed on the middle of the back, but not always entirely covering it, and pierced at the top with a little orifice, which serves for the passage of the egesta and the water necessary for respiration. This orifice conducts into the branchial cavity situated at the anterior portion of the back, and moreover widely opened above the head. On each side of the cavity, and symmetrically disposed, is a branchial pectination. The tentacles are conical, and the eyes are seated at their base externally. The sides of the foot are fringed with a row of filaments. The shell is conical, and much like that of a limpet;—the muscular impression on its inner surface is in the form of a horse-shoe. Fig. 2825 represents the animal and shell of Fissurella; Fig. 2826 the shell of Fissurella viewed from above. The genus Fissurella is very extensively spread; in its habits it is littoral, frequenting rocky beds and reefs at various depths, ranging from the surface to twenty-five fathoms.

2827.—THE CLOUDY FISSURELLA

(*Fissurella nimbosa*). According to M. Deshayes, three distinct species have been confounded together under the title of Fissurella nimbosa, from the time of Linnæus downwards.—The present is the species indicated by Lamarck, and figured by Martini.

2828.—THE ROSEATE FISSURELLA

(*Fissurella rosea*). The extremities of the shell in this species are raised, forming a sort of canal. It is a native of Guiana, &c.

2829.—THE GREEK FISSURELLA

(*Fissurella græca*). The shell of this species is conical. It is a native of the Mediterranean and the Indian Ocean.

The living species are very numerous; M. Deshayes enumerates thirty-three living, to which must be added twenty-nine species described in the Proceeds. Zool. Soc. 1834, p. 123, et seq. by Mr. Sowerby—two excepted, one by Mr. Frembly, the other by Mr. Gray:—all from the south-west coast of America, and the islands of the South Pacific Ocean. Of fossil species M. Deshayes gives eight as the number in tertiary deposits. Of these eight, three species are also living, viz. Fissurella Græca and F. costaria in the Mediterranean, and other seas of Europe, and also in the Indian seas, and F. neglecta, a native of the Mediterranean. It appears that another species, F. Noachina, still extant in the northern seas, occurs in a fossil state in Sweden and Norway. It is a link between Fissurella and Emarginula. The genus Emarginula presents nearly the same characters as Fissurella, excepting that the shell, instead of having an aperture at the summit, has an anterior fissure corresponding to a similar fissure in the mantle, which leads to the branchial cavity. This fissure is sometimes marginal, sometimes in the middle of the back of the shell. The edges of the mantle envelop and cover to a great extent those of the shell. The conical tentacles have the eyes seated on a tubercle at their outer base. The edges of the foot are fringed with filaments.

The shell is not regularly conical, but is very abrupt posteriorly, often even concave, with the apex bending backwards. Fig. 2830 exhibits in outline, the animal and shell of Emarginula. Fig. 2831 represents the shell of Emarginula conica, in which the fissure is marginal.

2832.—DE BLAINVILLE'S EMARGINULA

(*Emarginula Blainvillii*). This species is an example of a group of Emarginulæ in which the fissure is remote from the anterior edge of the shell, approximating towards the apex.

2833.—THE COMMON EMARGINULA

(*Emarginula fissura*). Patella fissura, Linn. The Emarginula fissura is a native of the seas of Europe, and affords an example of those species which are distinguished by a compressed form, with the anterior border deeply notched, and the summit strongly marked. *a*, the natural size; *b*, magnified; *c*, the magnified shell turned up, showing the animal in situ.

2834. THE EMARGINATE EMARGINULA

(*Emarginula emarginata*). In this species we have an example of a group in which the form is still more compressed, but in which the anterior border is only bent into a gutter; the summit is still prominent.

2835.—THE DEPRESSED EMARGINULA

(*Emarginula depressa*). This species of Emarginula represents a group, in which the form is much depressed, the summit very little developed and almost centrical, and the notch marginal but small. M. de Blainville has separated a group from Emarginula, and elevated it to the rank of a genus, under the title of Parmophorus. The Parmophori, says Cuvier, have, like the Emarginulæ, their shell in a great measure covered by the reflected edges of the mantle; the shell is oblong, slightly conical, and equally destitute of orifice or notch; the branchiæ and general organization are the same as in Fissurella.

Whether the Parmophori are separated from the Emarginulæ on good ground appears to be very questionable. M. Deshayes, in the last edition of Lamarck (1836), makes the following observations:—"Cuvier was the first who gave anatomical details of the genus Emarginula; and he made it appear how much analogy there existed between it and Fissurella. Sufficient differences nevertheless exist between these two genera, to warrant their adoption in systematic arrangements. But the same does not hold good with respect to the genus Parmophorus. M. de Blainville, to whom we owe this last genus, and who was the first to make the animal known, had judiciously preconceived the necessity of its junction with Emarginula. In fact, not only have the animals of the two genera a perfect analogy (affinity), insomuch that in some instances it is difficult to distinguish between them, but the shells themselves, as might have been supposed à priori, in some cases offer passages from one genus to the other, the number of which will be augmented by additional discoveries. When we have before us a fairly complete series of living and fossil species, belonging to the two genera, the following train of remarks suggests itself; namely, the two fossil species of Parmophorus have no trace of a marginal notch; Parmophorus Australis has the anterior border a little depressed in the middle, and corresponding with this depression, a small crest is to be seen within the shell, indicating the separation of the mantle. Further, among the species of Emarginulæ brought home by MM. Quoy and Gaimard there is one which they name Parmophoïda, and which would seem to be deprived of a marginal notch. In the Subemarginulæ of M. de Blainville the shells have no longer this notch, but they have within, a deep furrow (sillon) in place of it. In other species, as Emarginula rubra of Lamarck, and Emarginula elegans of Defrance, the small interior furrow is terminated on the border by a very short notch, and from this commencement (presenting the first trace of a fissure) to the termination of the series of species, we see this notch become deeper and deeper, and change at last into a deep slit occupying one-half of the height of the shell." M. Deshayes then proceeds to comment on the differences of the shells in other respects, as far as external form is concerned, observing that while from the general aspect of the shells the zoologist is induced to separate the genera, the structure of the animals themselves, on the contrary, forbids such a separation, as it affords no structural data on which the two genera can be respectively established. He adds that Mr. Sowerby has come to the same conclusions, and in his 'Genera of Shells' has united the Parmophori to Emarginula, an arrangement which other naturalists will, he doubts not, regard as warranted.

2836.—THE AUSTRAL PARMOPHORUS

(*Parmophorus Australis*). Emarginula Australis. In this example of M. de Blainville's genus Parmophorus, now merged into Emarginula, the shell is much compressed, and striated concentrically. It is a native of the seas of New Holland, New Zealand, &c.

In their habits the Emarginulæ resemble the Fissurellæ; they frequent rocks, at depths ranging from the surface to eleven fathoms.

With respect to fossil Emarginulæ Mr. G. B. Sowerby, in his 'Genera of Recent and Fossil Shells,' observes that they are scarce; they occur however, he adds, "in the calcaire grossier and its contemporary strata, in the crag of Suffolk, Essex, and Norfolk, and in the Bath oolite. They are very elegant little fossils, particularly Lamarck's Emarginula elypeata. We cannot consider his Parmophorus elongatus as a species of this genus, for its vertex is anterior, as its muscular impression demonstrates. Consequently we find in it no mark of a canal at either end; it must therefore be classed with Patella."

M. Deshayes in his tables enumerates seven living species of Emarginula, and eleven fossil species, from tertiary deposits: one, the Emarginula fissura, is both living and fossil; it occurs in the seas of Europe, and is found fossil in the crag at Bordeaux and Dax, and also near Paris (Pliocene, Miocene, and Eocene periods of Lyell). De la Bêche records two species in the blue marls of the south of France; one the E. reticulata of Sowerby, the other closely approaching the E. fissura. In the cretaceous group, De la Bêche enumerates two species, E. sanctæ Catharinæ and E. pelagica, both from Rouen. In the oolite group he records one species, E. scalaris, Sowerby, from the great oolite at Ancliff, Wilts.

M. Deshayes, in his edition of Lamarck, 1836, enumerates eleven species living, and only five occurring in a fossil state. The latter are E. costata and E. clypeata, from Grignon; E. radiola, from Parnes; and E. elegans, and E. clathrata, the first from Paris and Valognes, the other, a rare fossil, from Parnes.

With respect to Parmophorus of De Blainville, M. Deshayes in his tables gives two living and several fossil species, the latter from tertiary deposits. Of these, one is from Touraine, where it occurs in the Miocene beds of Lyell. He enumerates two from the crag; three from Touraine; three from Angers; five from Paris; and two from Valognes.

In his edition of Lamarck, only two species are noted as fossil, one the P. elongatus, which with a variety occurs at Grignon; the other P. angustus, from Paris.

Before we leave the family Fissurellidæ, we may revert to the observations with which we introduced it, namely, that M. de Blainville places it with the true limpets (Patella), in the same order (cervicobranchiata); whereas Cuvier disjoins this family from the limpets entirely, and that on the differences observable in the characters of the branchial apparatus.

M. de Blainville, indeed, maintains that in both groups the organs of respiration are in a cavity situated above the neck; that they exist in the form of pectinations in the Fissurellidæ, and in the form of a net or delicate meshwork on the roof (plafond) of the branchial cavity in the limpets, whence he terms them Retifera. On the contrary, Cuvier considers that the branchial organs of the limpet exist in the form of a fringe of filaments, forming a cordon under the edge of the mantle.

These two opinions are at perfect variance with each other; and if Blainville be correct, the arrangement of Cuvier must be defective. Assuming for the present, however, that Cuvier is right in his opinion, we shall follow him in assigning the Patellæ to a distinct situation from that in which the Fissurellidæ are placed, and when we come to the family Patellidæ, the first of the succeeding order, endeavour to give an outline of the observations of some of those conchologists who have investigated the subject.

ORDER CYCLOBRANCHIATA (CUV.).

THE Cyclobranchiate mollusks have the branchiæ in the form of little foliations, or pyramidal bodies like filaments, attached "en cordon," or in a row more or less complete under the edge of the mantle, nearly the same as in the Inferobranchiata, from which they are to be distinguished by their bisexual structure, each individual continuing the race independently. The heart varies in situation, but is not traversed by any part of the intestinal canal.

In a note (see 'Règne Animal,' vol. iii., p. 113) we learn that the Cyclobranchiata of Cuvier are not the Cyclobranchiata of M. de Blainville. Cuvier says, "M. de Blainville, who terms the order in which he places Doris" (one of the Nudibranchiata of Cuvier) "Cyclobranchiata, makes of the genera Fissurella, Emarginula, and Parmophorus, and of the Patellæ, an order which he names Cervicobranchiata; and which he divides into Retifera and Branchifera. The Retifera are the Patellæ, because he supposes that they respire by means of a network on the roof of the cavity which is above the head. I have not been able to discover or see any other organ of respiration besides the cordon of foliation which runs all round under the border of the mantle. See the anatomy of the Patella in my memoirs on the mollusks." These observations bring us to the first family:—

Family PATELLIDÆ (Limpets).

The Patellidæ, according to Cuvier, have the entire body covered with a shell in the form of a widened cone; under the borders of the mantle runs a cordon of small branchial foliations; the head is furnished with a short and thick proboscis, and two pointed tentacles having the eyes at their outer base. The mouth is fleshy and contains a spine-armed tongue, which is continued backwards and folded deeply in the interior of the body. The stomach is membranous; the alimentary tube, long, slender, and very much folded; the heart is placed forwards above the neck, and a little to the right.

To this detail of characters we may add a remark by Mr. G. B. Sowerby ('Genera of Recent and Fossil Shells'): he says, "there is no canal for the passage of water to the branchiæ, as there is in Emarginula and Siphonaria, for in this genus (Patella) the branchiæ are external, surrounding the animal." The want of access to a branchial cavity, if it existed, with its vascular network, is out of the question.

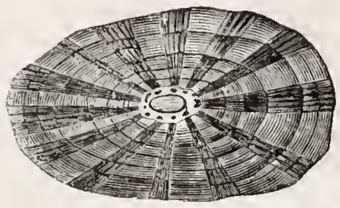
If we consult Rang, who follows Cuvier in his description of the mollusk of Patella, we find that he makes the following observation. "M. de Blainville believes that he has perceived the branchiæ of the Patellæ in a vascular network attached to the plafond of a branchial cavity. Not having been able to distinguish this network, we think with Cuvier that the organ of respiration shows itself in these animals in the circle of leaflets, which surrounds the body, between the foot and the mantle, as in the Phyllidians" (Inferobranchiata).

This circle of leaflets being always exposed to the action, no branchial cavity is needed, and as they are covered with minute cilia, they maintain a perpetual current over their surface, flowing from the outer to the inner edge, and thus fulfil the office of branchiæ.

M. Deshayes, in his edition of Lamarck's 'Animaux sans Vertèbres,' makes some valuable remarks on the structure and natural affinities of the Patellæ, in which he supports, with irrefragable arguments, the views of Cuvier, and points out the causes which led to M. de Blainville's mistake.

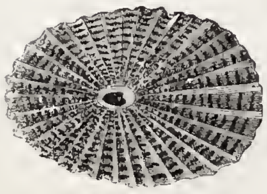
More recent observations confirm the correctness of these views, and demonstrate the truth of Cuvier's opinions. Fig. 2837 is a representation of the animal of Patella. The Patellæ are widely spread. They exist in every latitude, excepting in those of the arctic seas: many are common on the coasts of Europe, but it is in the hotter regions that they are most numerous, and display the largest dimensions. In their habits they are littoral, frequenting rocky coasts, where they are found fixed upon stones, reefs, and large shells; many crawl about, continually changing their resting-place, but some seem to be long stationary in one spot, to which they closely adhere. The depth at which they are found varies from the surface to thirty fathoms. They are said to live upon fuci and other sea-weeds, the substance of which is easily broken up by the action of their rasp-like tongue; yet we cannot imagine how such

2825.—Animal of Fissurella.



2826.—Shell of Fissurella.

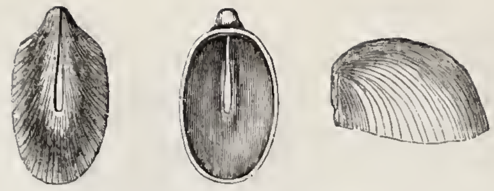
2827.—Cloudy Fissurella.



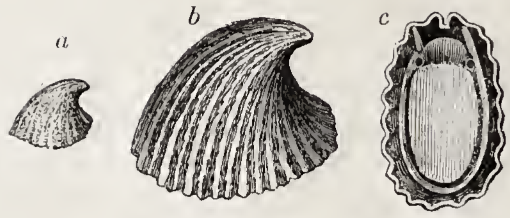
2829.—Greek Fissurella.

2830.—Animal of Emarginula.

2836.—Austral Parmophorus.



2832.—De Blainville's Emarginula.

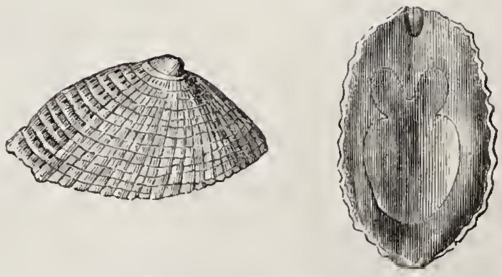


2833.—Common Emarginula.

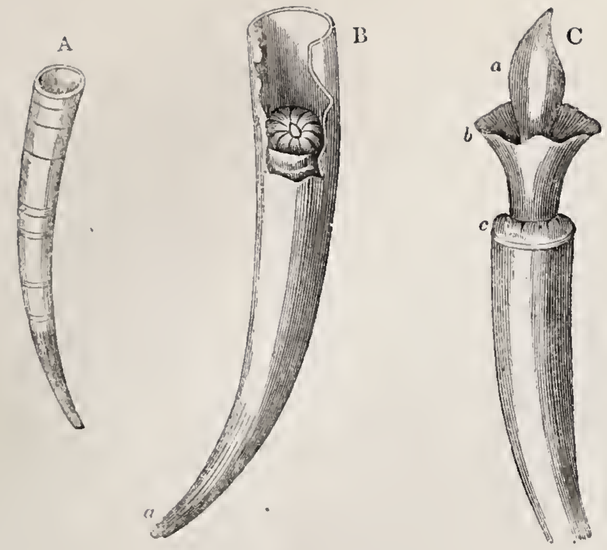
2835.—Depressed Emarginula.

2828.—Roseate Fissurella.

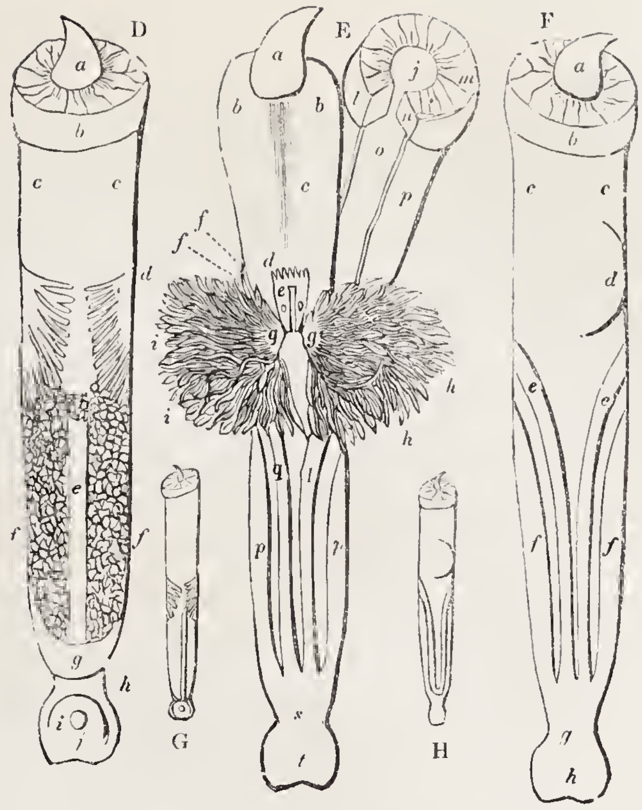
2831.—Emarginula conica.



2834.—Emarginate Emarginula.



2845.—Dentalium.

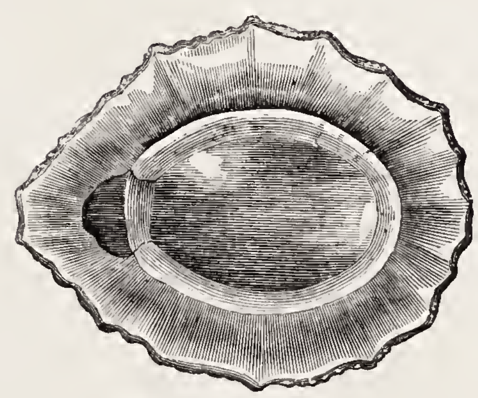


2846.—Animal of Dentalium.


2841.—Scutellar Limpet.


2840.—Compressed Limpet.

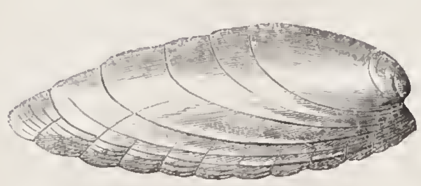

2837.—Animal of Patella.


2842.—Spoon shaped Limpet.


2838.—Common Limpet.


2843.—Pectinated Limpet.


2839.—Gilded Limpet.


2844.—Boat-shaped Limpet.

species as are long affixed to one spot can obtain this aliment: they must derive their nourishment from the animal and vegetable particles with which the water is abundantly charged.

Those who have been in the habit of observing limpets on the rocks of our own coast, cannot fail to have observed that in many instances the shell is, as it were, let into the rock to some depth, and that evidently by the operation of the mollusk in excavating a cavity which is adapted precisely to the form and size of the shell. It is not very easy to explain, in a satisfactory manner, the mode by which this wearing of the rock is accomplished. Some are inclined to attribute it to the effect of absorption; others to the perpetual action of a current of water, caused by the action of the branchial fringe around the mantle; and others to the agency of some secretion by which the structure of the rock is decomposed.

Some species adhere to shells, and the same effect is produced as on the rock.

In an admirable paper in the 'Philosophical Transactions' for 1833, on the economy of molluscous animals, Mr. Gray, speaking of a foreign species (the Patella cochlea), often found at the Cape of Good Hope, states that it lives "almost exclusively attached to a large species of the same genus, on the surface of which it forms a flat disk exactly the size of its mouth. To form these flat disks (of which there are generally two—one on each side of the apex of the larger Patella, so as almost to form a character of the species), and to assist in the increase of its size, the animal appears also to absorb the coralline or other similar substances with which the larger shells are abundantly covered. The common Patella of our own coast, when long adherent to another shell of its own species, to chalk, or to old red sandstone, or limestone, also forms for itself a deep cavity of the same form as its shell, and evidently produced by the dissolution of the surface to which it is affixed."

It is a remarkable fact that the limpet adapts the rim of its shell to the shape or irregularities of the substance to which it adheres. This has been often noticed, and is dwelt upon by Mr. Gray. He observes, that, "when a Patella or a Crepidula has attached itself to the flat surface of a rock, or the leaf of a large fucus, the base of its shell is flat, and its mouth roundish; when it adheres to a concave surface, such as the cavity of an old shell, the base becomes flattened, and convex internally; and when it fixes itself on the round stalk of a fucus, the sides become compressed so as in some measure to clasp the stem, and the lateral portions of the base project beyond the front and hinder parts to such an extent, that when placed on a flat surface it rocks backwards and forwards. Several nominal species of these and allied genera depend on variations in the shape of the shell, caused by the adhesion of the animal to surfaces of different forms: thus the Patella pellucida of Montagu is synonymous with the P. cærulea of the same author, the former having been founded on specimens taken from the stalk, and the latter on individuals obtained from the flattened frond of the fucus, on which the species usually takes up its abode. It is indeed by no means rare to find specimens in which the animal has moved from one of these positions to the other, and in such cases the shell represents P. cærulea, and the base P. pellucida, or *vice versâ*. The same change takes place with regard to P. miniata and P. compressa. I have in my collection a specimen of this latter shell, which is P. miniata at the top, it having in its youth lived on the frond of a large Cape fucus; it afterwards removed to the stem, and became compressed, and consequently is in this part the P. compressa; but by some accident it was again induced to change its situation, and removing to a flat surface, the edge of the mouth expanded, and it became a second time P. miniata, or perhaps what may be called by some authors P. saccharina, as this also appears to be a conical variety of the same species. Lamarck has described a similar specimen; and Mr. Sowerby, in his 'Genera of Shells,' has figured an example of this species, showing the two states. In like manner the Crepidula porcellana, when applied to a flat surface, has an expanded base and a flattened inner lip; but when adherent to a convex body, such as the stem of a sea-weed, or, as frequently happens, to the back of another shell of the same species, the animal being pressed into the cavity, the inner lip becomes concave, and the sides of the aperture are contracted. In this state the shell is called by some authors C. fornicata.

"When the shells of this family are adherent to irregular surfaces, they adapt their margins to the irregularities with which they meet. I have several specimens from the coast of Devonshire, having one or more processes on their sides which fitted into holes in the rock to which I found them attached; and such changes are the more remarkable, as some specimens are seen constantly moving from place to place, whilst others appear to remain for a long time fixed to one spot, and even those that are stationary in the young state constantly elevate the margins of their shells when the tide is low."

From this circumstance it is evident that many varieties of these shells may be mistaken for distinct species, of which indeed the catalogue is very extensive. To this point Mr. G. B. Sowerby ('Genera of Shells') has made express allusion, and adduced some instances in which such a mistake might very pardonably be made.

From these preliminary observations we proceed to notice a few examples, each the representative of one of those subgeneric groups founded by M. de Blainville on external configuration.

Section *α*. This group is composed of such species as have a nearly true conical form of shell, with the apex obtuse, vertical, and almost exactly mesial.

2838.—THE COMMON LIMPET

(*Patella vulgata*). This species is abundant on the coasts of Europe, and few have visited the rocky shores of our island without having noticed it, if, indeed, they have at all attended to the living productions of the sea, which many who visit what are termed watering-places never even dream of. Many an hour which drags heavily with the ennuyé would pass agreeably were such objects sought after and observed; but sorry are we to say that to some Nature has little attractiveness, little to interest or delight. Such a man exists as though he existed not, —he loses half the pleasures allotted to human enjoyment.

Section *β*. In this section the species are less conical, and the apex is placed more anteriorly, with a slight inclination forwards.

2839.—THE GILDED LIMPET

(*Patella deaurata*). This species is found in the Straits of Magellan, or Magelhaens, on the shores of the Falkland Isles, &c.

Section *γ*. In this section the species are elongated, oval, and compressed at the sides, with the apex anterior, and inclined forwards.

2840.—THE COMPRESSED LIMPET

(*Patella compressa*). The species is a native of the Indian Seas.

Section *δ*. In the species included under this division the form of the shell is extremely flat, or depressed, and the apex very slightly developed, and somewhat anteriorly placed.

2841.—THE SCUTELLAR LIMPET

(*Patella scutellaris*). This is a singular form, with an irregular margin, and furrows radiating from a little abrupt conical apex.

Section *ε*. This contains species depressed like those of the preceding section, but which differ in being much narrower anteriorly than posteriorly.

2842.—THE SPOON-SHAPED LIMPET

(*Patella cochlearea*). The under surface of this example is represented. It is a type of the genus Helicon of De Montfort.

Section *ζ*. This section is composed of oval species, with a well marked apex, decidedly inclined forwards.

2843.—THE PECTINATED LIMPET

(*Patella pectinata*). This is a pretty species, found in the Mediterranean Sea.

Section *η*. In this section the species have the shell delicate, oval, nacreous, with a festooned margin; the apex is marginal, anteriorly.

2844.—THE BOAT-SHAPED LIMPET

(*Patella cymbularia*). This species is so different in the form and appearance of its shell that, at first sight, it might scarcely be recognized as belonging to the present genus.

Though the living species of Patella are extremely numerous, M. Deshayes enumerating a hundred and four, yet the fossil species are very limited, and of these one, Patella equalis, is existing in the seas of Europe: it is met with, fossil, in the crag. According to Mr. Sowerby fossil forms of Patella occur in the oolite, in the lias, in the Oxford clay, and the chalk marl, of the secondary series; also in the calcaire grossier, and probably the London clay of the tertiary series, together with the crag—the pliocene of Mr. Lyell.

Before leaving the genus Patella we may notice that termed Scutella by Mr. Broderip, established on some shells collected by Mr. Cuming among the islands of the South Pacific. Unfortunately the living animals had been destroyed before the shells were taken, probably by some carnivorous creature; but, though proof positive is wanting, Mr. Broderip is inclined to refer the genus to the Cyclobranchiata. See 'Proceeds. Zool. Soc.,' 1834, p. 47.

With respect to the genera Siphonaria, Patelloida, and Lottia, which in the form of the shells closely resemble the Limpet (Patella), yet, as the mollusks differ greatly in organization, having a single pectinated branchial apparatus on the right side, as in Fissurella, and not a cordon of filaments, they must be referred to the Scutibranchiata, to which order, as we have said, Fissurella and Emarginula belong.

We now turn to the genus Dentalium, respecting the position of which there is yet no little difficulty.

By the earlier writers the Dentalium was regarded as an annelid, one of the Tubicolæ, and even Cuvier, in the last edition of the 'Règne Animal,' retains it among those articulated creatures, observing, however, that the recent observations of M. Savigny, and more particularly of M. Deshayes, render this arrangement very doubtful. He adds,— "The animal does not present any sensible articulations, nor any lateral bristles, but it has anteriorly a membranous tube, in the interior of which is a sort of foot, or fleshy conical operculum, which closes the orifice; on the base of this foot is a small flattened head, and on the neck are the branchiæ, in the form of tufts. If the operculum reminds us of the foot in Vermetus and Siliquaria, which have been restored to the Mollusca, the branchiæ have much resemblance to those of Amphitrite and Terebella. Farther observations on the anatomy of Dentalium, and principally on the nervous and vascular systems, will resolve the problem."

It is to M. Deshayes that the discovery of the real nature of the Dentalium is owing, and his opinions respecting its being a true mollusk have been fully confirmed. Linnæus arranged Dentalium after Patella, and before Serpula; and Lang placed it in a group after Patella, together with all the calcareous tribes of Annelids then known. Brugières gave it almost the same position as Linnæus.

M. de Blainville, in his 'Malcologie,' 1825, agrees with M. Deshayes in assigning the Dentalium to the Mollusca, and he establishes it as the type of an order, which he terms Cirrhobranchiata, and places next to Patella. M. Rang, in 1829, follows M. de Blainville, but places the Cirrhobranchiata, of which Dentalium is the only representative, between Fissurella and Patella. Mr. Gray, who has compared the description of the animal given by M. Deshayes with specimens in the British Museum, is inclined, we believe, to consider its place in systematic arrangement as approximating to the Fissurellæ, but yet at a considerable distance. With respect to the British species Mr. Gray observes, that the apices often appear to be broken or worn off, and that the animal, for protection, then forms a slight tube within, which is more or less produced beyond the tip; and the late Dr. Turton described a specimen so repaired as a distinct species under the name of Dentalium labiatum. Several specimens of the common Dentalium are now before us, and every one has the tip perfect, and the edges of the small apical orifice are smooth and polished.

In placing this genus after Patella,—we do not mean thereby to indicate that such is its true situation,—doubtless it is the type of a distinct family and perhaps order, for which De Blainville's name of Cirrhobranchiata is very appropriate.

The shell in Dentalium is very simple; it is an elongated cone, slightly curved, and open at each extremity by a rounded orifice.

The animal is of a conical elongated form, the dorsal surface corresponding with the convexity of the shell, the ventral surface with the concavity. The whole anterior part of the animal is invested by a fine membrane, which is fixed posteriorly to the origin of the foot, and is free in front where its circumference is thickened. It is perforated in the centre; the thickened portion is muscular. Dividing this mantle down the middle surface of the back, the foot, head, and branchiæ are brought to view. The foot is elongated, subcylindrical, slightly conical, and fleshy. The head consists of a mouth only, and is situated superiorly at the hinder extremity of the foot. The respiratory system consists of two branchiæ symmetrically situated on the lateral and posterior parts of the neck, and supported on a divided peduncle. They are composed of many very fine, soft, flexible, tentacular filaments, with club-shaped terminations, and appear from their position to be equally adapted for directing nutriment towards the mouth, and for fulfilling the task of aërating the blood.

The form and characters of Dentalium will be better understood by reference to our pictorial specimens than by a long verbal description.

Fig. 2845 represents the shell and animal of Dentalium entalis: A, the shell of Dentalium entalis, of the natural size; B, the shell magnified and broken longitudinally, showing the animal in a contracted state; *a*, the posterior extremity prolonging itself into a small accidental tube; C, the shell magnified, with the animal at the moment of its advancing out in order to obtain food; *a* and *b*, the foot, the lobes of which are developed in the form of a corolla; *c*, a part of the collar of the mantle.

Fig. 2846 represents the animal extricated from the shell, in different views: D, the animal magnified, the abdominal aspect; *a*, the extremity of the foot; *b*, the collar of the mantle; *d d*, the liver; *e*, the intestinal tube; *f*, the egg-sack; *g*, the muscle of insertion; *j* and *h*, the expanded expansion, which is funnel-shaped, and called by Deshayes the pavillon; *i*, egestive orifice; F, the same, dorsal aspect, magnified; *a*, extremity of the foot; *b*, the collar; *c c*, the mouth; *d*, a slight projection produced by the head and the branchiæ; *e e*, internal retractile muscles; *f f*, external retractile muscles; *g*, the neck of the pavillon; *h*, the pavillon; E, the same with the mantle slit along the dorsal and medial line, detached in part from its posterior insertion, and turned aside, so as to show the parts enclosed; *a*, the extremity of the foot, which closes the aperture *j*, of the collar *l m*, of the mantle *n o p*; *b b*, lobes of the foot; *c*, the foot itself, presenting a depression, or a channel running its whole length; *d*, the head: *e*, the cerebral ganglion; *f f*, the two jaws; *g g*, the peduncles of the branchiæ; *h h*, *i i*, the branchiæ; *p p*, *g g*, the retractor muscles; *s*, the muscle of insertion; *t*, the pavillon; G, the animal, one-fourth of natural size; H, the same, one-sixth of natural size.

The genus Dentalium is very widely distributed, few seas being destitute of some species. Generally these shells are found on sandy shores, in rather shallow water, but sometimes at considerable depth. The species, as enumerated by Deshayes, are twenty-three living, and thirty-four fossil in beds of tertiary formation. Four new species, from the shores of South America, will be found described by Mr. G. B. Sowerby in the 'Proceedings of the Zoological Society,' 1832, p. 29.

Family CHITONIDÆ (CHITONS; Les Oscabrions of the French).

The Chitons constitute a very remarkable group of mollusks, covered by a shell formed of eight distinct portions, arranged upon the back, in a single row, and attached to a tough leathery mantle, the edges of which extend beyond the borders of the plates; these latter are transverse, and overlap each other, constituting a sort of armour, very different, indeed, to the turbinated shell of most groups, or the conical shell of a limpet; they are differently marked and patterned in different species, and the border is mostly covered with scales, hairs, or spines. Thus protected, the Chiton can roll itself up like an armadillo, and stretch itself out again for the purpose of progression, or of attaching itself, limpet-like, to the rock. This power supposes an arrangement of muscles in connexion with the plates, in order that the mechanism of the armour may be complete. The foot of the mollusk is oval, and the branchiæ consist of small leaflets placed, as in Patella, in the furrow between the foot and the mantle. They are covered with cilia.

There is no projecting distinct head, and both eyes and tentacula are wanting. The mouth is furnished with a long tongue, rolled up spirally, and armed with horny teeth.

Fig. 2847 represents the eight shelly plates of Chiton, separated from the mantle, and from each other, so as to show their outline.

Fig. 2848 shows the shelly plates of an allied genus termed Chitonellus.

Fig. 2849 shows the animal of Chiton squamosus; *a*, the animal and shell seen from above; *b*, the animal seen from below; *c*, a side view of the shell and animal in a creeping or adherent state; *d*, a portion of the branchiæ magnified.

Though the Chiton has no affinity to the multivalve shells of Linnæus (the Lepas and Balanus, or barnacles), yet they were all associated together by that naturalist, forming an artificial group composed of a most heterogeneous assemblage; and though his arrangement has been long abandoned (Adanson having, indeed, demonstrated the true characters of the animal by careful observations, and Cuvier having confirmed Adanson's views by anatomical investigation), yet M. de Blainville has, in some measure, returned to the Linnæan arrangement, and formed a section of the mollusca, termed Malentozoaria, of which Lepas and Chiton form two classes. This arrangement, however, has not been adopted by other zoologists, who generally recognize the affinity of Chiton to Lepas.

The Chitons are specifically very numerous, and are found on most rocky shores; they attain to the largest size in the hotter climates, with some exceptions, for two large species occur on the shores of Tierra del Fuego; none, however, appear to exist in the high northern seas, and the British species are small. We may now turn to our pictorial specimens, of which such are selected as illustrate the minor groups into which the genus is for convenience divided.

Section *α*. In the species of this section the border of the mantle is leathery and naked. The following two species are examples.

2850.—The Chilian Chiton

(*Chiton chilensis*). This Chiton has the shell oblong-ovate, opaque, and thick, of a dark-brown colour, smooth and dull; the inside is white, with pink markings on the first, second, and last plates. The plates are marked by longitudinal striæ, and crossed by irregular concentric ridges. The anterior and posterior plates are semilunate, and slightly punctated; the second plate is subcarinated, with the front margin obtusely angled, the lateral margins arcuate; and the posterior margin with a prominent beak, on each side of which diverges a rather elevated granulated ridge; the next five valves are alike bow-shaped, with a granulate ridge on each side. The border is smooth, coriaceous, or leathery, tough, thick, and of a darker colour than the shell; it is semipellucid, broad at the sides, and narrow anteriorly and posteriorly.

This species of Chiton is found on the shores of Valparaiso, in the crevices of rocks, and under stones.

2851.—De Blainville's Chiton

(*Chiton Blainvillii*). In this curious species the border of the mantle is greatly enlarged anteriorly and contracted posteriorly; it is of an orange red, and fringed here and there, not with hairs, but with little coriaceous filaments. The shell is roundish, the anterior plate is obscurely ranged, the posterior one small and abrupt, the others are concentrically lineated. The general colour is roseate varied with white, brown, and greenish; inner surface white.

This Chiton is found on the shores of the Inner Lobos Island, coast of Peru.

Section *β*. In this section the mantle-border is smooth, but with tufts of hair at the lateral extremities of each plate.

2852.—The Tufted Chiton

(*Chiton fascicularis*). This is a small species found on the southern coast of our island, and also in the Mediterranean. Specimens from the Barbary coast are stated by Montagu to measure not unfrequently an inch in length. British specimens measure about five-eighths of an inch in length, and rather more than two-eighths of an inch in breadth. The shell is apparently smooth, but, when examined by a glass, presents a rough shagreened surface, except along the elevated dorsal ridge; around the margin, at the junction of each plate, is a tuft of whitish hair; besides two tufts in front, making altogether eighteen. The colour is brown or cinereous.

Section *γ*. In this section the mantle-border is covered with hairs.

2853.—The Peruvian Chiton

(*Chiton Peruvianus*). The Peruvian Chiton has the border of the mantle narrow and coriaceous, and thickly covered with long coarse black hairs. The shell is oblong-ovate, opaque, of a dirty yellowish green, or yellowish brown; the inside is white. The plates are thin and slightly elevated, having the posterior compartments a little raised; they are minutely striated. From between each emerges a series of short black hairs, which lie on the back of the shell.

This species of Chiton is found under stones at low water, on the shores of Valparaiso Bay. Its length is two inches, its breadth one inch and a-half.

Section *δ*. In this section the mantle-border is beset with spines.

2854.—The Spinose Chiton

(*Chiton spinosus*). In the Spinose Chiton the shell is brownish black: the plates are opaque, those anteriorly placed are granulated over the entire surface, those posteriorly are granulated at the sides. The border of the mantle is wide, and beset with long aculeated blackish spines, closely resembling those of certain Echini. Total length three inches.

This is a very rare species, and according to Peron is a native of the South Seas.

2855.—The Spiniferous Chiton

(*Chiton spiniferus*). Chiton aculeatus, Barnes, not Linnæus. This is a large species, with the shell opaque, oblong-ovate, reddish brown, and glossy; the inside is reddish white. The posterior angles of the plates do not overlap the anterior edges of the succeeding. The first plate has generally nine rows of raised dots diverging from the apex, but the number appears to vary with age; the second plate is rather acutely beaked and carinated, longer than the five following, which are striated and shaped alike, carinated, with an acute beak, and presenting a row of elevated dots. The last plate is striated and beaked, with a row of raised dots under the beak. The border is coriaceous, thick, broad, rough, and of a greenish or orange colour. In young specimens it is thickly covered wtih blunt spines, but in old shells the spines are short and scanty, and generally covered with corallines.

This species attains to the length of five or six inches, but it is then destitute of beauty, the sharpness of the pattern on the shell being lost, and the spines covered with a dirty coat of calcareous matter, so often observed encrusting old shells and other submarine bodies, the result of precipitation.

Mr. Frembley, who found this species on the rocky coasts of Valparaiso and Chili, states, that it frequents exposed situations, and is often found adhering to the rocks over which the sea breaks with great violence, where there is no little danger as well as difficulty in obtaining them; they are generally covered with sea-weed.

Section *ε*. This section is distinguished by the border of the mantle being scaly.

2856.—The Coquimbo Chiton

(*Chiton Coquimbensis*). The shell of this species is ovate, narrow, and opaque;—while young, its colour is of a glossy greenish brown; the inside blackish. The anterior plate is marked with numerous undulated concentric ridges, and all except the first are rather acutely keeled and beaked—a ridge diverges on each side from the beak, forming a sagittate figure; below which are longitudinal striæ. The border is thick, moderately broad, and covered with coarse seed-like scales, which are attached laterally. As the animal advances in age, the middle of the plates, which are very solid, become eroded, and covered with limpets, balani, &c. The only locality, Mr. Frembley says, in which he found this species was on the south side of the coast of Coquimbo Bay. In its habits it resembles the preceding species, excepting, as he states, that it appears to be more gregarious.

Section *ζ*. In th : group the border of the mantle is granulous.

2857.—The Magnificent Chiton

(*Chiton magnificus*).[1] It is very difficult to give by mere words an idea of the patterns which the shells of the Chitons present, and of the form of the separate plates. Mr. Frembley, whose details we follow, characterizes the shell as dull, opaque olivaceous, and dotted with lighter-coloured spots, with the inside glaucous. The first plate has regularly radiating striæ crossed by concentric ridges; the posterior margin is nearly straight. The other plates are obtusely beaked, and divided laterally into two compartments, the anterior having regular longitudinal striæ, crossed by others very minute and concentric; from under the beaks diverge to the lateral margins of the plates coarse and more irregular striæ, which raise the posterior compartment above the other. The last plate has a well-defined apex leaning towards the posterior margin. The border is thin, moderately broad, and covered with fine shining bead-like granulations of the same colour as the shells.

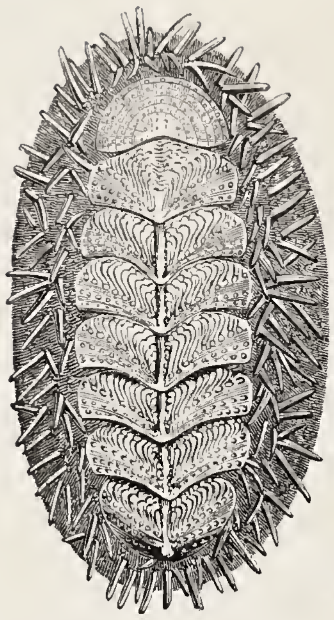
This species is the Chiton olivaceus of Frembley; but it had previously received from M. Deshayes the title of magnificus. It grows to the length of about five inches; and is found on the coast of Chili. We now come to the genus or sub-genus Chitonellus, which contains such species as have the border highly developed, and the valves very small; in some species, indeed, they are often almost entirely hidden under the skin of the mantle, so that the animal has almost a naked appearance; the body is often almost vermiform. Fig. 2858 represents two examples:—*a*, the smooth Chitonellus (Chitonellus lævis); *b*, the larviform (Chitonellus larvæformis).

Whether the genus Chitonellus is founded on solid grounds is very doubtful; a series of gradations leads from the more completely armour-clad Chitons to such as have the plates rudimentary and hid in the mantle; and there is no point in the series at which a line of generic demarcation can be drawn. Its retention may nevertheless be convenient. It would seem that fossil species of the Chiton are of rare occurrence. We learn from Mr. Sowerby that detached valves are occasionally found near Paris, in the calcareous sand and in the crag of our island. M. Deshayes, in his edition of Lamarck, gives one species from the tertiary of Grignon, discovered by M. Defrance, and a second species belonging to the transition rocks in the neighbourhood of Tournay, due to the researches of MM. Duchastel and Puzos.

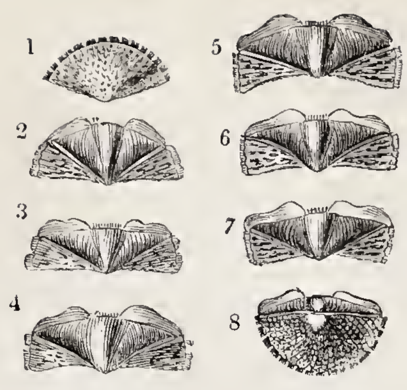
Here then we leave the Gastropodous Mollusks; we have given a sketch of their principal forms, from the Slugs and Helices to the slug-like Chitons covered with their shelly plates, not, we trust, without having conveyed some degree of information to our general readers, who wish to know more of these animals than what may be learned from a mere examination of the shell. We now commence the review of another class, namely, the Bivalve-shelled Mollusks, or Acephalous Mollusks of Cuvier, the latter term implying the absence of a distinct head.

CLASS CONCHIFERA.

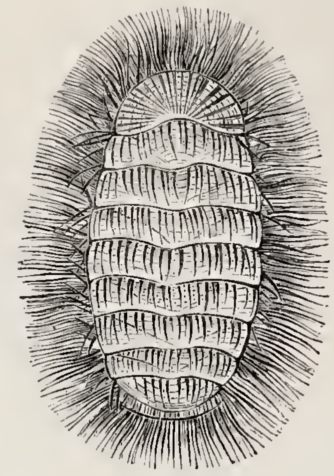
BIVALVE-SHELLED MOLLUSKS, OR ACEPHALOUS SHELLED MOLLUSKS (*Les Acephales Testaces* of Cu-



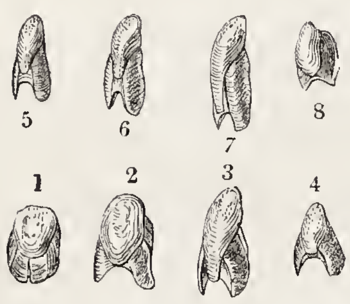
2855.—Spiniferous Chiton.



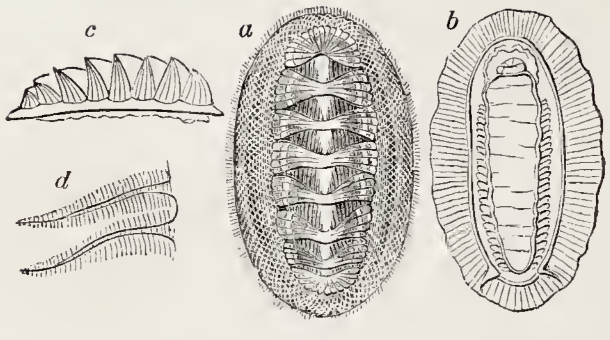
2847.—Shelly Plates of Chiton.



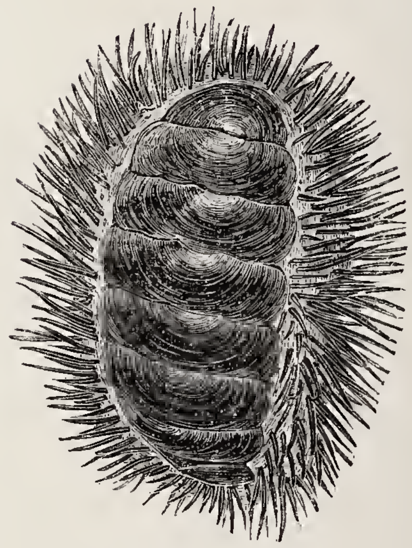
2853.—Peruvian Chiton.



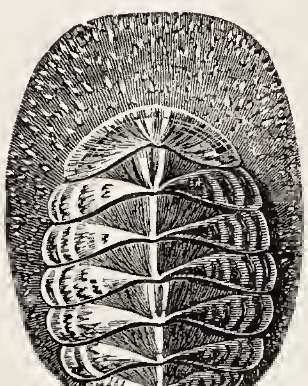
2848.—Shelly Plates of Chitonellus.



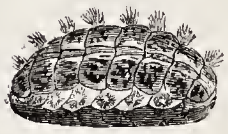
2849.—Animal of Chiton squamosus.



2854.—Spinose Chiton.

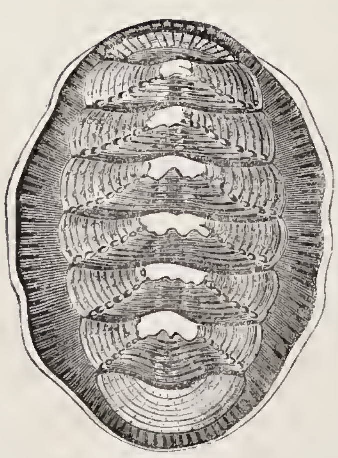


2851.—De Blainville's Chiton.

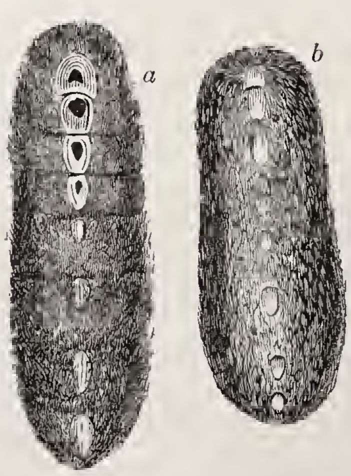


2852.—Tufted Chiton.

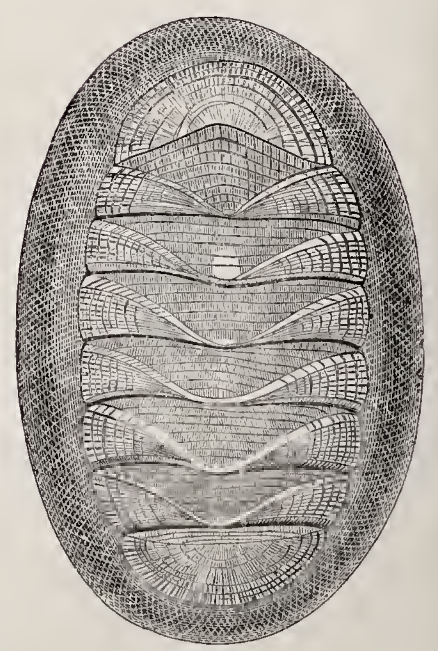
2856.—Coquimbo Chiton.



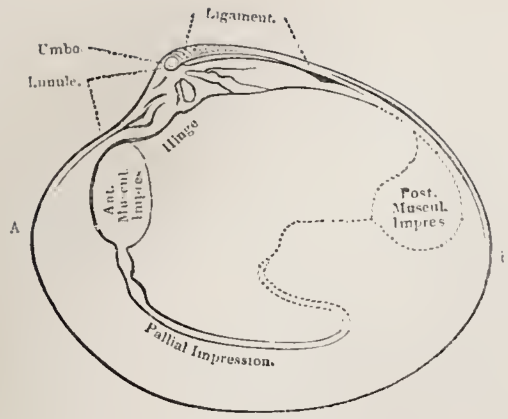
2850.—Chilian Chiton.



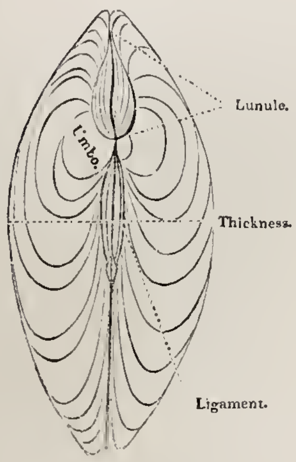
2858.—Smooth (*a*) and Larviform (*b*) Chitonellus.



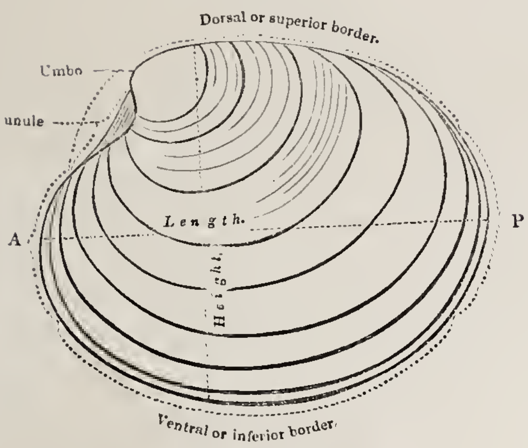
2857.—Magnificent Chiton.



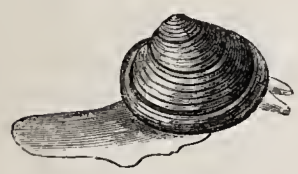
2861.—Cytheræa.

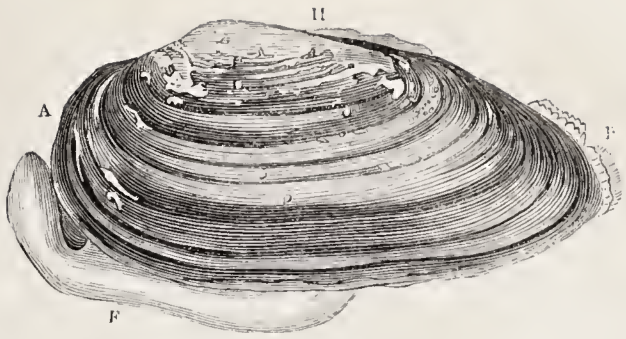


2860.—Cytheræa.

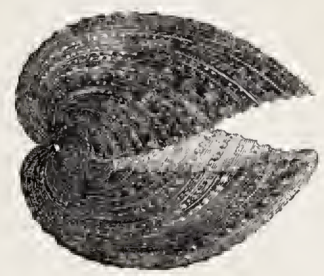


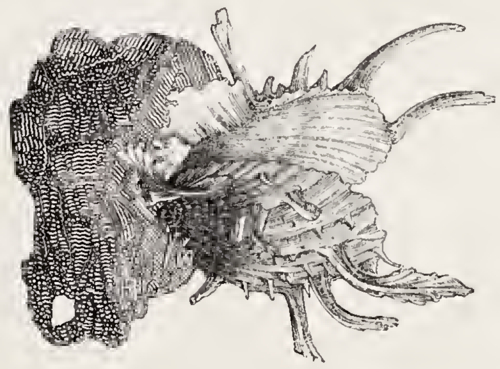
2859.—Shell of Cytheræa.


2865.—Cyclas cornea.



2866.—Unio pictorum.


2864.—Venus's Heart.


2862.—Prickly Oyster.


2863.—Cock's-comb Oyster.


2867.—Oyster-boats.


2868.—Oyster-dredger.

vier; *Lamellibranchiata*, De Blainville).—Under this class Lamarck associates all the mollusks inclosed in bivalve shells, including also the Brachiopoda, which however constitute in the arrangement of Cuvier a distinct class, and as such we shall consider them.

The number of species belonging to the Conchifera almost exceeds imagination. They pave the shallower parts of the ocean, where the shells, accumulating as the animals die, form deep beds, which at some future epoch, when the sea shall have left its present situation, may attract the attention of geologists, and excite their speculations as to the condition of this planet at the remote epoch of their deposition. It is thus as we examine the various strata, the clays, the chalks, the limestone rocks which abound in the fossil bivalves of ages past, that we muse over the state of our globe, when the sea was where hills and rocks are elevated; and thus shall it be again, as Time rolls on developing the ceaseless agencies of change which lie hid in this planet, or are inseparable from the operations, chemical or mechanical, of nature herself.

The Conchifera are invariably aquatic, and, as we see in the oyster, are attached to the valves by one or more muscles destined for closing the valves together, and retaining firmly shut. Such shells as have only one adductor muscle are termed *Monomyarians*; such as have two are termed *Dimyarians*. In the Monomyarian shells it is the posterior muscle which is present, and there are often some very minute traces of an anterior muscle. The valves are united at their back by means of a hinge; this hinge is formed by the inner layer of the shell, and consists either of a simple cardinal process, or of a serrated edge, or of projections or teeth which fit into corresponding cavities. To this is superadded a ligament which binds the two parts together, and keeps the teeth or projections in their places. This ligament is either internal (being hidden by the cardinal edge), or external. It is wonderfully elastic, composed of fibres compacted together, and perpendicular to the valves they connect; and its office is to open the shell when the adductor muscles, of which it is the antagonist, are relaxed. After the death of the animal, when these muscles lose their power, owing to this elasticity of the ligament the valves gape wide, more so than during the life of the mollusk.

But before proceeding, we may here give a brief explanation of the external characters of a bivalve shell, and for this purpose let us consult the Figs. 2859, 2860, and 2861. The form varies.—that of Cytheræa we select as an example. The semicircular lines on the upper surface at Fig. 2859 indicate the stages of progressive increase, by deposition from the mantle or pallium, which, as we shall hereafter explain, covers the animal. The line from A to P gives the longitudinal measurement of the shell; the cross line indicates its height. The rounded and more or less elevated apical portion is termed the Umbo, and anteriorly but below this is a depressed space, very conspicuous in some shells, called the Lunule; on the other side is the elastic ligament. The lunule, umbo, and ligament are included within the dorsal or superior border; the opposite edge is termed the ventral or inferior border.

Fig. 2860 is the same shell, its dorsal aspect displayed, showing the lunule, the umbo, the ligament, and the thickness.

Fig. 2861 exhibits the inside of the shell, showing the lunule, the umbo, the hinge, or cardo, and the ligament—the anterior muscular impression or mark of attachment—the posterior muscular impression, and the impression made by the edge of the mantle, or pallial impression.

As specimens of monomyarian shells we refer to the prickly oyster (Spondylus), Fig. 2862, and to the cock's-comb oyster (Ostrea crista galli), Fig. 2863. The shell called Venus' Heart (Cardium cardissa), Fig. 2864, one of the cockle tribe, is dimyarian.

Shut up in their shells, these mollusks have but limited sources of animal enjoyment, and little communication with objects around them. They grow—they purify the waters of the sea—and afford food to various creatures tenanting the briny deep, to birds and quadrupeds haunting the shore, and to man. Their nervous system is very simple; they have no organs of hearing, sight, or smell, yet would it seem that their whole surface is influenced and affected by light, by sounds or vibrations of the water, by odours, and liquid stimulants. It is asserted by fishermen that oysters in confined beds may be seen, if the water is clear, to close their shells whenever the shadow of a boat passes over them.

Though we say that these mollusks have no organs of vision, we must not forget that certain brilliant specks have been detected in the pecten, or scallop, placed at short intervals round the thickened edge of the mantle, and these, Poli and some other naturalists regard as eyes; if they be so, they are certainly placed on the only part of the animal where their use could be available. In Spondylus similar specks have been observed.

With respect to locomotion, these animals are very limited. Some, however, as the fresh-water mussel, are capable of raising themselves on the edge of their half-opened valves, and of urging themselves along, by the aid of a muscular organ called the foot; and in this way they proceed by successive impulses; and we have often watched the fresh-water mussel thus proceed in shallow clear water, leaving a long furrow in its track on the soft mud over which it pushed its course. Some, as the cockle, can leap a considerable height, and clear the gunwale of a boat, and also burrow in the sand by means of the same muscular instrument. Others, as the scallop, by opening and flapping together the valves, swim freely, with a rapid desultory movement; and on the shore effect a backward progression by the same action. Others again, as the pholas, perforate rocks and masses of chalk, in which they take up their abode; and the teredo pierces its way into the hulls of ships, floating wood, the timbers of piers, of jetties, and of other works, which have cost man labour and capital.

On the other hand, many bivalve mollusks are firmly fixed to the rocks, or to other shells, by a calcareous exudation that cements their shell to the surface; and, as in the oyster, clusters are often compacted into large beds or masses. Others attach themselves to the rocks by a cable or byssus, as the common mussel and the pinna: this cable consists of threads analogous to those formed by the silkworm and other caterpillars, or by the spider. The threads exude, in a glutinous state, from a peculiar organ at the base of the foot; they are not spun by being drawn out, but are modelled, so to speak, by the foot itself. If we examine the foot of a mussel or of a pinna, we shall find a groove extending from its root to its apex; the edges of this groove fold over, so as to form a minute canal. Along this canal runs the glutinous matter, gradually becoming tenacious. At the proper moment the animal protrudes its foot, and its tip attaches the end of the filament to the stone or rock. This done, it expands the tongue-like foot, so as to open the canal and free the filament from its sheath. The foot is then withdrawn, new matter is poured along the groove, and thus the operation is repeated till the cable is secure. It is said that the pinna is capable of producing only four or five threads in twenty-four hours; the exudation and hardening of these threads being a tedious process.

Moored by their cable, these mollusks secure themselves against the tide and the rolling of the agitated waters.

In Italy, gloves and other articles are manufactured from the threads of the pinna, for the purpose of being sold as curiosities. They may be seen in most museums.

We must not omit to state that the views respecting the threads of the byssus which we have just detailed, and which are generally received, differ materially from those of M. de Blainville. He does not regard the byssus as the result of secretion, but as an assemblage of muscular fibres, dried up in one part of their extent, but still contractile and in a living state at their origin, and that they were in this condition throughout their whole length at the time of their attachment to the rock. The tendinous feet of byssoarca and tridacna seems to be, as he conceives, a step towards the organization of a true byssus.

In pursuing our observations on the bivalve mollusks, our remarks will be best understood if we take a given species as the subject of our notice. We select one with which all are familiar,—viz. the oyster; time immemorial one of the delicacies of the table. The Greeks and Romans held these "shell-fish" in great estimation; those of the Dardanelles, of Venice, of the Bay of Cumæ, and of the coasts of Britain, were the most esteemed. But the Romans attached the greatest value to such as were brought from these places and deposited in the Lucrine Lake, where they grew very fat. Sergius Orata, at Baiæ, was the first Roman who entertained the idea of modifying oysters into "natives" by placing them in artificial oyster-beds.

If we take one of these shell-fish, and carefully open the valves of its shell, we shall observe a broad free-floating membrane, continued from the skin or soft integument. It appears in the form of two outer leaves, one lining each valve of the shell. These membranes, between which is the body of the mollusk, constitute the mantle, or pallium. Let us now turn back one of the leaves, or lobes, as they are often termed, of the mantle, and we shall see two pairs of most delicate striated lamellæ, consisting of parallel fibres: these, commonly called the oyster's beard, are the gills, or branchiæ.* Between these two pairs of branchiæ, near the hinge, are slips or appendages, enclosing the mouth. We shall see also a firm, extensive adductor muscle at the lower and outer side of the body; and above this a mass, consisting of the liver and the viscera, the heart lying between the liver and the inner side of the adductor muscle, in a cavity or fissure, which is very apparent. Such are the external appearances presented by the oyster, in which no foot is developed, though it is slightly so in the scallop, and greatly in many bivalves, as the cockle, &c.

The mouth is a simple orifice, bordered by four long lips, near the hinge of the shell, and opens almost immediately into the stomach, which, through several orifices, receives the bile secreted by the liver, a large mass of follicles loosely connected together by a delicate tissue, and constituting the epicurean morsel of this mollusk. The alimentary canal, proceeding from the stomach, winds through the liver, making a loop near the heart. In some mollusks its course is more complex: in the cockle tribe, for instance, it takes its course through the substance of the foot, and in others passes through the centre of the ventricle of the heart.

We need not here repeat that the gills or branchiæ are the aërating organs. In those creatures, however, they serve also for another and very important purpose. It must strike every one who sees an oyster, and considers how inertly it lies attached to its native rock, or upon the bed whence it has been taken, that some special means of procuring food must be possessed, since the animal has neither the power of following its prey nor of seeing and seizing it; and herein the branchiæ fulfil a secondary but most essential office. The water flowing into the shell and traversing these branchiæ contains abundance of animalcules and animal and vegetable particles, on which the oyster subsists. By the action of minute cilia, to be seen only by means of a microscope, by which the filaments of the branchiæ are thickly covered, strong and incessant currents are produced in the water, their course being directed to the mouth, and with them the nutritious particles on which the mollusk lives. The lips enfolding the mouth are endowed with a sense of discrimination, which rules them as to what particles to reject and what to receive; and thus a constant supply of food is obtained. The action of the cilia is incessant, and goes on when the shell is closed, agitating the water previously taken in. Nay, such is their "vis vitæ," that even when a portion of the branchiæ is cut away they continue their movements on the detached piece so long as their vitality remains, and row it rapidly through the water, as if it had an independent existence.

The branchial filaments, which are very apparent, are minute vessels running a parallel course, and exposing the blood to the water; they are enveloped in delicate tissue, and, communicating with each other, ultimately merge into two principal trunks, conveying the renovated and purified blood to the auricular cavity of the heart, whence it passes through two canals to the ventricle, and is thence distributed, by means of innumerable arterial ramifications, through the body. In some tribes there are two auricular cavities, one for each pair of branchiæ; and in Arca there are two auricles and two ventricles distinct on opposite sides of the body.

To the office and structure of the mantle we may now direct our attention. As in the gastropods, it is the shell secreting and depositing agent.

In the oyster the free margins of the mantle are very limited, and are unconnected in any part of their circumference with each other: but in other tribes the mantle has its free edges more developed, and the two leaves are more or less completely united along their edges, so as to form an investing cover, in which the body lies shrouded.

In the mussel, for instance, the edges of the mantle are united with two orifices, one for the protrusion of the foot, the other at the posterior extremity of the shell, forming a rudimentary siphon for the rejection of the egesta. In others again, as the Chamidæ, or clams, the circumference of the mantle is united, leaving three apertures, one for the protrusion of the foot, one for the entrance of water to the branchiæ, and one for the escape of the egesta.

In the Cardium, or cockle family, the mantle prolongs itself posteriorly into a double tube, or siphon; and in the mactra this double siphon is very long, extending beyond the shell. Sometimes these siphons are separate, sometimes conjoined. They are eminently contractile, and fringed with papillæ of great sensibility. The upper siphon is that through which the excrementitious matters are thrown off, while the lower one is destined to convey water to the branchiæ.

The Siphoniferous Bivalves, with long tubes, are burrowing in their habits. By means of their foot they scoop out a retreat in the sand or mud, and hence it is that the mantle is lengthened into a

* Hence M. de Blainville's term for the Conchifera, viz. Lamellibranchiata.

double posterior siphon, protruded from the mouth of their burrow, for the purpose of respiration and the discharge of effete matter.

Fig. 2865 represents the Cyclas Cornea: its large foot protruded, and two posterior siphons are very conspicuous.

Fig. 2866 represents a common fresh-water shell, the Unio pictorum. A, the anterior extremity of the shell, P, the posterior extremity, with the two siphons or tubes; H, the hinge; F, the foot.

We have hitherto only alluded to the mantle of such Bivalves as when their shells are closed are completely shut up, no aperture being left, the valves therefore requiring to be opened for the protrusion of the siphon. But there is a group called 'Les Enfermés' by Cuvier, because the mollusks are completely enclosed in their mantle, while the valves remain open, from their shape, at each extremity. Such are the Solen, or Razor-shell, the Pholas, and others. The shell of the Solen is long and cylindrical, and open at both ends: the siphon, or double tube, is protruded from the posterior orifice, and the foot from the anterior, near to which, on the back edge of the valves, interiorly, are two or three tooth-like projections, fitting into each other. The rapidity with which the Solen or Razor-shell, called by the French Manche de couteau, or knife-handle, can bury itself in the sand is very remarkable. Its foot is the instrument employed for this purpose, and the depth the creature penetrates is often several feet, baffling all endeavours to capture it.

In the rock-boring Pholas the two valves of the shell are convex, broad anteriorly, becoming narrow posteriorly. A large oblique fissure is left at each extremity. Through the anterior fissure the foot is protruded: the double tube through the other.

In the Teredo the mantle is produced into a siphon, much longer than the two small rhomboidal valves; and this tube is always so placed, while the animal is boring its way, as to have free access to the water.

We have already said that it is the mantle which secretes the shell. The latter, as we know, consists of carbonate of lime, cemented together by a viscid animal matter, which dries, the whole becoming hard and solid.

Now, if we examine the mantle, say of a muscle, which we shall find lining the shells, and enwrapping the body, we shall find its margins considerably thickened, and adherent to the edge of each valve.

In the oyster they are quite free, but still thickened; and this thickened edge is glandular, and often, as in the scallop, furnished with a delicate fringe of sensitive tentacles.

In many instances it is seen to contain certain patches of different colours, corresponding both in tint and relative position with those presented upon the surface of the shell. These coloured patches are glandular, and owe their colouring to the pigment they themselves secrete.

Now, in order to increase the dimensions of the shell, the margins of the mantle are protruded, each being firmly adherent to the circumference of the respective valve which it lines. The margin then pours out the mixture of gluten and lime, depositing it on the edge of the shell, when it hardens, and remains fixed. At intervals this process is repeated, and every newly formed layer enlarges the extent of the valve. The concentric strata, thus deposited, remain distinguishable externally, marking the progress of increase by these lines of successive additions.

At certain times the deposition of shelly matter is more abundant than at others; and the size and distance of the ridges denote this circumstance. Sometimes at such periodical epochs the mantle shoots out, by a sudden development, beyond its usual extent, depositing broad raised plates, or spines, which remain permanent, the mantle retiring to its ordinary state: another epoch comes, and a fresh plate, or row of spines, is added, and so on, with intervals, marking the successive developments of the mantle, produced by the periodical stimulus to increased action.

While the shell-secreting glands pour out their produce, the colour-glands pour out *their* pigment, mixing it with the yet viscid matter composing the shell, which it tinges. When this secretion of colouring matter is kept up uninterruptedly, the tinted marks or lines of the shell will be unbroken; but if the secretion be poured out at intervals, the markings will be broken, and spots, dashes, and other ornamental stains will be the result; and these will be larger and bolder as the shell increases in growth.

We have said that a viscid secretion is mixed with the carbonate of lime in shells: if, as is the case in some species, this viscid fluid is in more than sufficient abundance to set the lime, it formed on the surface a sort of parchment, like tissue, or a horny layer, generally known under the name of Epidermis. In some species this layer is thick,—in some it becomes loose, fibrous, and shaggy, like coarse hairs, or the fibrous investment of a cocoa nut.

Shells are lined, as we know, with a smooth, glossy, and often iridescent coating, called mother of pearl, or nacre. The deposit of this in some species is very abundant, giving great thickness and solidity to the shell. This nacre is secreted by the external surface of the mouth, not by its fringed and thickened edge. It is, in fact, added as a smooth coating after the hardening of the shell, and constantly added to as the valves increase.

Pearls, we need scarcely repeat, are nothing but nacre: they are the products of the mantle under certain circumstances. Local irritation of various kinds will cause their formation: minute grains of sand, conveyed by accident between the valves, and sticking to the mantle, often form the nuclei of pearls. They become covered with concentric layers of nacre, which soon increase, forming detached globular pearls. Many of the minute boring annelids perforate shells, when the mantle, by way of blocking them out, secretes under the effects of the stimulus an unusual and irregular abundance of nacre, which, enlarged by successive layers, forms pearls adherent by a wider or narrower base to the interior of the valve. Linnæus stated that he possessed the art of procuring pearls at pleasure, by drilling a small hole in the shells, and then introducing through it a grain of sand, or the like.

We have stated that the valves of these mollusks are closed by means of a muscle or muscles, which counteract by their contraction the elastic spring of the hinge. Now on a little consideration it will be plain that as the shell increases by the addition of matter to the ventral edge, the position of the adductor muscle or muscles must gradually change in order to maintain their relative place to the circumference of the shell. They must in fact maintain the same situation in the adult as in the young. In the oyster, for example, it is quite obvious that the adductor muscle which was connected with the thin and minute lamellæ forming the first shell, has during its growth become farther removed from the hinge, and transferred moreover from layer to layer of nacre, as the shell increased in thickness and its circumference enlarged.

The question arises, how does this muscle, which we find so firmly adherent to the nacre lining the valves, became thus altered in its position? It must then first be premised that there is a thin layer of the mantle interposed between the muscle and the shell, so that in fact the muscle is not extrapalliate; and this thin part of the mantle increases the nacre, which adds to the thickness of the shell, as much under the extremities of the muscle, as the rest of the surface of the mantle does elsewhere. Here then we have a clue to the gradual shifting of the muscle. Particle after particle is laid on between the muscle and the shell, whilst the rest of the mantle is adding equally to the general surface of the valves, so that a new layer has formed, extending farther than the previous layer, to meet the increase of the shell; and thus is the adhesion of the muscle imperceptibly transferred to a new surface of nacre, and at the same time advanced forwards; and thus, during the growth of the shell and mollusk, is this operation insensibly but gradually taking place: so that if we were to peel off the nacre in layers, we should find the muscle-mark in a more and more backward position as layer after layer was removed. In short, the growth of the shell and the addition of a fresh and more extensive layer of nacre are more or less consentaneous, and each increased layer of the latter will carry the muscle forward so that it will always retain its due relative position. The bivalve mollusks are most probably all bisexual. The eggs in many are not abandoned at the time of their exclusion, but are deposited between the membranes of the branchial laminæ, exposed to the ciliary currents of water, where they undergo a sort of incubation. In some in fact the shell is developed before they quit this receptacle. Sir Anthony Carlisle says, "Oysters are viviparous, and the young are found within the tracheal (branchial) passages, and between the folds of the coverlet (mantle) during the months of June and July in this climate. In its first state the oyster exhibits two semi-orbicular films of transparent shell which are continually opening and closing at intervals. The whole brood are associated together by being involved in a viscid slime, and in that state called *spat*, it being common among viviparous animals of this kind to have their spawn posited in contact with the lungs (branchiæ); the involving slime serves as the first nutriment, and we may infer that the food so influenced by the gills (branchiæ) is at the same time a respiratory supply to the imperfectly formed young."

The breeding months of the oyster are May, June, and July, and during this season they are unfit for food. When the *spat* is ripe for being deposited, it becomes attached to stones, rocks, shells, &c., and myriads of young become developed at the same time, forming immense beds, for the supply of man.

It is, however, from artificial rather than from natural beds that the vast quantities are obtained which supply our markets. Brood or young oysters of small size are collected and transplanted into favourable spots, which are strictly protected, and become a productive source of profit both to the dredgers and the public. In parts of the coast where no particular rights exist, the beds become much thinned, and the brood is often carried away and planted in beds under protection, where they multiply in abundance. Newly formed beds are generally kept untouched for two or three years, to allow for the growth of the young. Of the age attained by the oyster little is known; some suppose it to be about ten years. In three days after the spawn is deposited, the young oysters are inclosed in a shell three lines broad; in six months the shell is nearly as large as a half-crown piece; at the end of a year it equals a dollar. After a certain period, the mollusk ceases to grow, the shell is large in proportion to the bulk of the animal, which becomes thin, gradually diminishes in size, and is unfit for food. Oysters when put to fatten into small pits in the saline marshes, as we have seen along the Swale, with the water about three feet deep and abounding with marine vegetable matter and animalcules, assume a green tinge in three or four days, and are excellent. The oysters taken at Dieppe are of a greenish hue. In Spain they have a reddish tinge.

The most celebrated beds for native oysters are those at Milton in Kent, at Colchester, Maldon, Feversham, and Queensborough. Those in the Swale and Medway are in high repute. In Scotland the beds in the Frith of Forth and in Musselburgh Bay afford good oysters. In France the oysters from Brittany have been long famous; those from Dieppe are very excellent, but the oysters obtained near Canealle, a town not far from St. Malo, have the highest reputation. From the Swale and from Rochester and Colchester vast numbers of oysters are exported to Holland and Germany. From the island of Jersey 200,000 bushels are annually exported, and 250 boats, 1500 men, and 1000 women and children are employed in the season. Dredging for oysters is carried on generally in fleets, as the beds lie within a comparatively small space. The boats are about fifteen feet long, and usually carry two men and a boy. The dredge is about eighteen pounds' weight, but it is required to be heavier on a hard than a soft bottom. Each boat is provided with two dredges; but the fishermen complain that in the early part of the season too great a number of dredges, and those of too heavy a kind, are used, which injure the beds, so that the latter part of the season is rendered less profitable than the commencement.

A fleet of oyster-boats putting out early in the morning, crossing and intersecting each other's course as they advance to the fishing-ground, their white sails glancing in the sun, and anon as the boats tack about becoming shadowed, and again brightly glancing, is a most interesting spectacle. Such a scene is represented at Fig. 2867. Fig. 2868 represents an oyster-dredger in his usual dress, casting the dredge over the gunwale of his boat.

From this introduction we may advance to the consideration of our pictorial specimens, of which we first select those belonging to the scallop and oyster family.

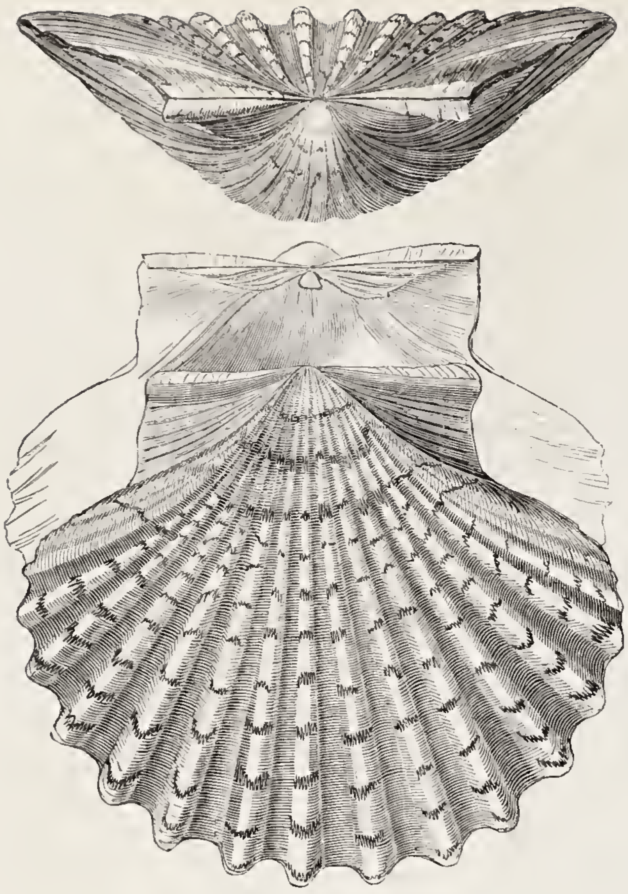
MONOMYARIA.

Family PECTINIDÆ (Scallops, Oysters).

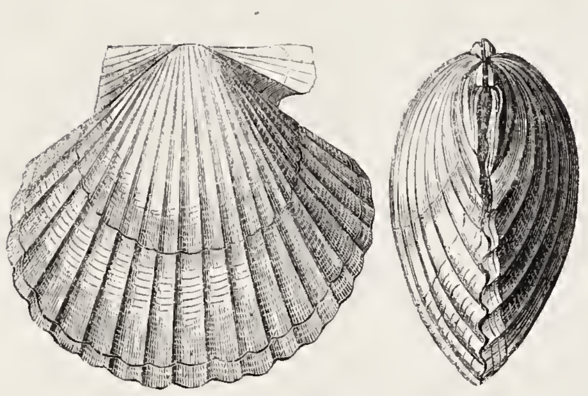
The shells of bivalves have what is termed a right and a left valve; and which is the right and which the left valve may be generally determined by placing the shell on its edge, with the anterior part, denoted by the umbo and lunule, forwards, and the hinge and ligament next the observer.* We notice this because M. de Blainville divides the Pectens into four groups; first, into those specimens which are very inequivalve, the left valve being very flat, as in the common scallop; secondly, into equivalve species; thirdly, into species in which the two valves are nearly equally concave, but the right rather the least; and, fourthly, into such as have striæ parallel to their border. Mr. Sowerby makes five divisions. Now in the Pecten, from the situation of the umbo and the characters and place of the hinge, the right and left sides can only be determined by the position of the animal.

The genus Pecten is thus characterized by M. Deshayes. Mollusk subrotund, not thick; lobes of the mantle very delicate, disunited throughout, thickened on the borders, and furnished with many rows of fleshy cilia, between which are regularly

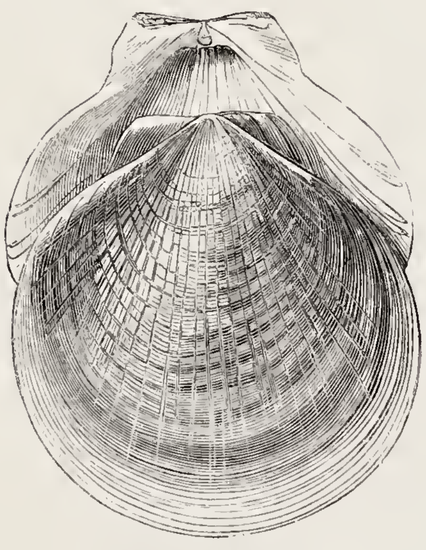
* Many reverse this, and call the lunule portion of the shell the posterior, and the long part, with the hinge, and with the siphons of the mollusk, the anterior part; indeed, Mr. G. B. Sowerby states this to be the general plan: if so, it is contrary to common sense; much confusion and contradiction, however, accrue from it, as it reverses the valves, and makes what ought to be called the left the right, and vice versâ. In our views it is the right valve of the oyster that is the convex one, the left the flat one. "Il faut se souvenir (dit Cuvier) que le ligament (de la charnière) est toujours du côté posterieur des sommets" (umbones).



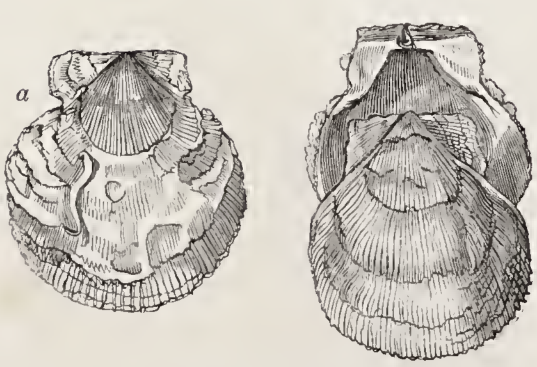
2869.—St James's Cockle.



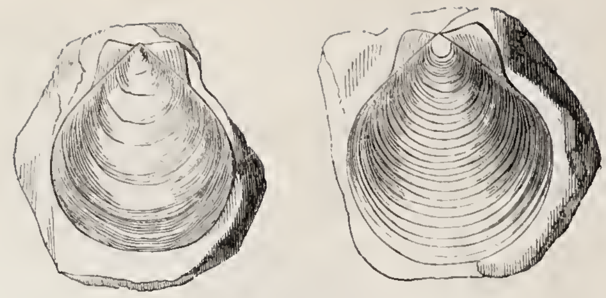
2871.—Gibbous Scallop.



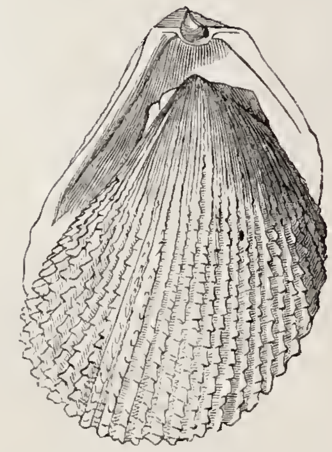
2870.—Flounder Scallop.



2873.—Sinuous Hinnites.



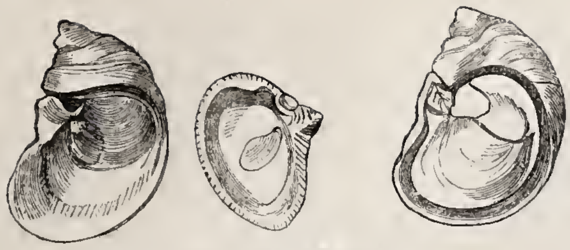
2872.—Orbicular Scallop.



2874.—Squamous Lima.

2875.—Spondyloid Pedum.

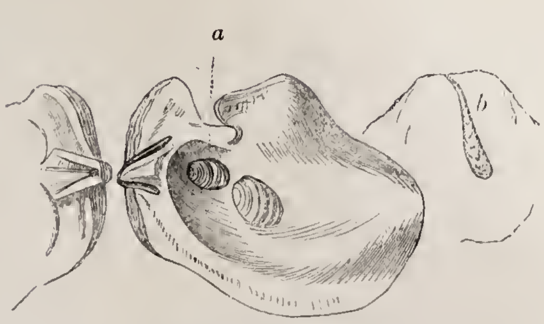
2876.—Incurved Gryphæa.



2877.—Conical Exogyra.

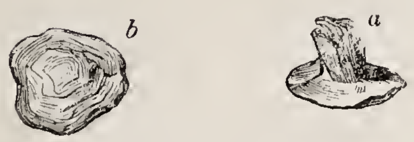
2878.—Cock's-comb Oyster.

2879.—Chinese-Window Oyster.



2880.—Cuming's Placunanomia.

2881.—Saddle Anomia.



2882.—Bony Appendage of Anomia.

2883.—Anomia squamata.

disposed series of smooth oculiform tubercles; branchiæ large, decomposed into detached filaments. The foot small and dilated at its extremity; mouth rather large, and oval, surrounded by projecting and deeply-cut lips, and furnished on each side with a pair of triangular palps, truncated at their extremity. The shell is free, regular, and auriculated; umbones contiguous; hinge toothless; the cardinal pit entirely internal, and receiving the ligament. The auricles or earlets of the shell are those projections on each side of the umbo, extending some distance downwards.

Mr. Garner, in his paper on the Lamellibranchiata ('Trans. Zool. Soc.,' vol. ii.), considers the foot of Pecten to be an organ for the prehension of food collected by the vibratile currents near the mouth: it has but one slender muscle. In one of the figures accompanying his paper he delineates one of the eye-specks on the edge of the mantle, with its optic nerve, magnified.

Speaking of the Lamellibranchiata generally, he observes, that those species which, like the common mussel, are exposed to the action of the sun and air on the bare rocks, have the valves fitting to each other most exactly—preventing all evaporation; but when the valves are open at any part, the animal either inhabits deep water, as many species of Pecten, or has the power of burrowing in the mud or sand when left dry by the ebb of the tide.

The scallops, as we have said, move rapidly backwards in an undating manner by flapping their valves. Several species abound in our seas; and some are considered as delicacies. The common scallop, or St. James's cockle (Pecten Jacobæus), when well treated by a good cook, is said to make a rich and excellent dish. When so prepared, these shell-fish are termed "Quins," in allusion to the great tragedian and epicure, whose judgment in the delicacies of the table was unquestioned.

The shells of some species of Pecten are thick and heavy, others again have the shell very light, and some, as the Pecten vitreus (Gray), from the Arctic Circle,* as transparent as glass. The determination of the species, in many instances, is not easy. Some are most beautifully coloured, but in others the tints are sombre and unvariegated.

2869.—THE COMMON SCALLOP, OR ST. JAMES'S COCKLE

(*Pecten Jacobæus*). This shell, the well-known badge of the pilgrim from the Holy Land, is common in the seas of Europe and along our southern coasts. The shell is unequivalve—the upper or left valve being flat, the under or right valve concave internally. Each valve has from fourteen to sixteen angulated rays; those of the lower valve are sulcated longitudinally. It occurs in a fossil state in tertiary deposits in Italy.

2870.—THE FLOUNDER SCALLOP

(*Pecten pleuronectes*). This species is a native of the Indian seas, and has its name from the circumstance of the upper valve being of a rich reddish-brown, while the lower one is white—being thus bi-coloured, like a flat-fish. The shell is subequivalve, rather thin, smooth externally, somewhat convex on both sides.

2871.—THE GIBBOUS SCALLOP

(*Pecten gibbosus*). The shell of this species is subequivalve, ventricose, and red; with from twenty to twenty-two convex rays, somewhat rugose at their sides and at the interstices. It is a native of the Atlantic and American oceans.

2872.—THE ORBICULAR SCALLOP

(*Pecten orbicularis*). This species occurs only in a fossil state, and is found in the chalk and other formations in England and France. It is suborbicular, with one valve smooth, the other marked with transverse concentric striæ.

The fossil species of Pecten are very numerous, as are those now existing. Of the latter, M. Deshayes enumerates thirteen as occurring also in a fossil condition in tertiary strata. Fossil species are found in the chalk, the oolite, and other ancient deposits.

Closely allied to the genus Pecten is that termed Hinnites. Though most naturalists assert that there is no byssus in this genus by means of which the animal moves itself to stones, Mr. Sowerby decidedly asserts the existence of this natural cable; and though, from the singular manner in which the shell becomes pressed to and takes the shape of the substances to which it is pressed, its adhesion by means of the valves is only apparent; its real attachment being by a byssus, and not by cement uniting the shell to the rock.

* An allied species, Pecten vitreus of King, not Gray, was found everywhere in the Strait of Magellan, attached to the fronds of the Fucus giganteus, and formed great part of the food of the Steamer-Duck.

2873.—THE SINUOUS HINNITES

(*Hinnites sinuosus*). As an example of this genus we give this species, the Pecten pusio of authors, common in our British seas. The shell is ovate, unequally sinuous, variegated with brownish orange and white, and marked with numerous very narrow rays like striæ.

A small number only of living species belonging to this genus is known; and four or five fossil species are found in some of the tertiary beds of France and Italy.

Our next specimen belongs to the genus Lima. In this genus the animal is oval, having the lobes of the mantle separated nearly throughout their extent, larger than the valves of the shell, and turned inwards; this part of the border is wide, and furnished throughout its extent with numerous tentacular elongated and annulated cirrhi. Branchiæ rather large, equal, and separated (écartées); foot cylindrical, vermiform, rather club-shaped, and terminating in a small sucker (ventouse), by means of which the animal can fix itself to submarine bodies; no byssus; buccal aperture oval, furnished with large foliaceous lips, terminated on each side by triangular and obliquely truncated labial palps.—(Deshayes.) Shell longitudinal, subequivalve, auriculated, rather gaping on one side of the valves; umbones distant (écartées), their internal facets incline inwards. Hinge toothless. Cardinal pit partly external, receiving the ligament.

In the species of the genus Lima the foot has a particular form. It is elongated, narrow, cylindrical, and rather thickened at its free extremity, where it terminates in a sort of sucker, which, according to the observations of M. Quoy, serves to fix the animal upon solid bodies even of the most smooth surface. The mouth is placed between two lips comparable to those of Pinna: they are foliaceous, descend upon the lateral parts of the body, and terminate on each side in a pair of labial palps, which are truncated and triangular. The branchiæ are rather large and equal. The adductor muscle seems more extensible than in the greater part of the mollusks of the same class. When it is not contracted, the valves are widely opened, and the animal has the power of impressing on it frequent and sudden contractions, the rapidity of which is facilitated by the extreme elasticity of the ligament of the valves. By means of these reiterated contractions the animal can flutter in the water, to use the happy expression of M. Quoy, and one must run after it to catch it among the corals or in the shallows where it dwells. Though the species are not numerous, the form is widely spread, and is generally found in the seas of warm and temperate climates. A few are natives of the British seas.

2874.—THE SQUAMOSE LIMA

(*Lima squamosa*). This species is a native of the seas of America. The shell is oval and depressed; the hinge is oblique; the margin crenated: it appears as if clipped anteriorly. Colour white. The ribs are squamous, rough, and file-like. M. Deshayes enumerates thirteen fossil species in tertiary beds. One species is found in the inferior oolite.

Another genus, belonging to the section embracing the true Pectens, is that termed by Lamarck Pedum. The mollusk of Pedum is thus characterized by M. Deshayes:—Animal oval, oblong, flattened, having the lobes of the mantle open throughout their circumference, thickened on their edges, and furnished on this part with many rows of tentacular cirrhi, and, at regular distances, tubercles with smooth surfaces. A pair of large branchiæ descending on each side to the edge of the lower border of the mantle; abdominal mass small, having anteriorly and high up a small vermiform foot, and at its base a silky byssus of some size; mouth oval, having on each side a pair of labial triangular palps. (Deshayes.)

With respect to the shell Lamarck gives the following characters:—Shell inequivalve, subauriculate, lower valve gaping; umbones unequal and distant. Hinge toothless; ligament partly external, inserted in an elongated canaliform pit, which is hollowed out in the internal wall of the umbones. Lower valve notched near its posterior base. (Lam.)

2875.—THE SPONDYLOID PEDUM

(*Pedum spondyloïdeum*). This is the only species, we believe, at present known belonging to the genus Pedum. It is described and figured by MM. Quoy and Gaimard in the 'Zoology of the Voyage of the Astrolabe.' It is a native of the Indian seas, the coasts of the Isle of France, and of the island of Vanikoro, where the French naturalists observed it in great numbers, living partially encased in madrepores, such as Astræa, &c. M. Quoy is of opinion that the animal is capable of hollowing out excavations in the blocks of madrepore, in which to take up its residence; and he found young and adult individuals tenanted holes proportionate to their respective sizes. M. Deshayes, indeed, seems to doubt this burrowing power, and suggests that the animal having first attached itself to the coral, its shell gradually becomes enveloped by the growth of the coral. Granting, however, this to be the case, still the young shell which is enveloped, and inhabits a cavity proportionate to its size, must have the means of enlarging it according to its own increase of growth. The colour of the shell is whitish, tinged with red; the lower valve is the largest, with the lateral edges turned up, and raised above those of the superior valve; the byssus passes out through the deep notch below the hinge of the lower shell.

We now come to the section of the Pectinidæ known as oysters, under which range several genera, some of which, as Gryphæa, are found principally in a fossil state, others, as Exogyra, only so.

Between the genus Gryphæa and Ostrea there is an insensible passage, so that in a large series of species and varieties it would be impossible to draw the line between the two genera. In both, the lower valve is always the largest; in both, the hinge and muscular impression are similar; in both, the shells during the period of youth are fixed for a longer or shorter period, becoming free as they advance in age; and even the involute curvature of the umbo of Gryphæa, perhaps the strongest point of distinction, is not constant in every species. Hence M. Deshayes would abolish the genus altogether, and with these views Mr. G. B. Sowerby coincides.

Provisionally retaining Gryphæa, we may observe, that while the living species amount, we believe, to only one (G. angulata), the fossil species are very numerous, and are found in almost all strata down to the lias inclusive.

2876.—THE INCURVED GRYPHÆA

(*Gryphæa incurva*). This fossil species is from the lias. In his last edition of Lamarck, M. Deshayes enumerates thirty-four fossils which Lamarck would assign to this form.

Whatever doubt there may be about retaining the genus Gryphæa, none exists with respect to the untenableness of the genus Exogyra as distinct from Ostrea. It possesses in fact no distinguishing characters at all; although that eminent geologist Von Buch regards it as clearly and decidedly separate. The genus Exogyra was proposed by Say for such species of Gryphæa as have the umbo taking a lateral direction, instead of rising above the valves, with a tendency to a dorsal angle, at least in some species. The latter character therefore is by no means constant; and with respect to the former, many oysters exhibit the same tournure of the umbo, though perhaps not carried out to the same extent.

We have already stated that all the species attributed to this genus are fossil.

2877.—THE CONICAL EXOGYRA

(*Exogyra conica*). The example selected occurs in the upper green-sand, gault, and lower green-sand.

We now turn to the genus Ostrea, namely, that of which the common oyster (ostrea edulis) is an example.

This genus is divided by many writers into two groups: 1. True oysters, with simple or undulated, but not plaited valves; 2. True oysters, with the borders of their valves distinctly plaited.

To the first group belong the common oyster and between thirty and forty living species, distributed through various seas, principally in warm and temperate latitudes; no species appear to have been discovered in the Polar Ocean. In the hotter climates they abound, in æstuaries and along the coast; and are often found attached to rocks and even to trees which border the water. In this strange situation is taken the mangrove-oyster of the West Indies, so highly prized for its delicious flavour, and in company with it a species of Perna, which is accounted even still more excellent. An old traveller, one William Davies, who quitted England on the 28th of January, 1597, is ridiculed by an anonymous writer in the 'New Monthly Magazine' for 1829, for asserting that he had seen oysters and mussels growing upon trees, and eaten them; as did also Obwer Noore, a Dutchman (1665), in Guinea. The same writer ridicules the idea of crabs feeding on the fruit of trees; yet oysters are found adhering to trees, and there are tree-crabs (Birgus Latro) which feed on the fruit—consequently such ridicule proves only that the writer's information in natural history was very limited.

2878.—THE COCK'S-COMB OYSTER

(*Ostrea Crista-Galli*). This remarkable species is an example of the second group, which contains more than thirty recent species. It is a native of the Indian seas. The shell varies in form according to the shape of the body to which it adheres, but is generally somewhat rounded and very much plaited, the plaits being longitudinal and angular. Externally the colour is violet, purplish or reddish white.

The fossil species of the genus Ostrea are very numerous; they occur as low in the series of strata as the lias limestone, inclusive: M. Deshayes, in his last edition of Lamarck, gives the number as eighty-two.

From the genus Ostrea we advance to the genus Placuna, of which those large diaphonous and almost circular shells to be observed in most collections are examples.

The genus Placuna presents the following characters:—The shell, which is very much flattened, is of a regular figure, and not adherent to other bodies. The valves are almost translucid, quite so in some species, and nearly equal; the hinge is internal, and offers on one valve two longitudinal rib-like elevations converging at the summit, and on the other two corresponding furrows for the attachment of the ligament. The muscular impression is nearly centrical and rather small.

The mollusk does not appear to be known. Three living species are recorded, and one fossil, in tertiary deposits.

The living species inhabit the Indian and Red Seas.

2879.—The Chinese-Window Oyster

(*Placuna Placenta*). The valves of this shell are sufficiently transparent to admit light; they are suborbicular, flat, and white, with longitudinal decussate striæ. It inhabits the Indian Seas, and is taken on sandy bottoms.

In the 'Proceeds. Zool. Soc.' for 1832, p. 28, Mr. Broderip characterizes a genus which he terms Placunanomia, forming, as its name indicates, an intermediate link between Placuna and Anomia. The generic characters are detailed as follows:—

Shell adherent, subequivalve, irregular, flattened, plaited towards the margin, vitreous internally. Hinge internal, with two elongated, thick, subcurved, divaricated teeth converging at the base in the lower valve, and two ligamentiferous furrows opposite in the upper valve. Lower valve superficially fissured externally towards the hinge, the subosseous organ of adhesion inserted between the laminæ of the shell and filling the fissure externally. Muscular impression in each valve subcentral. In the upper valve the impression of the organ of adhesion is superadded. (Broderip.)

The learned founder of the genus follows up these characters, with the annexed observations:—

"This interesting genus partakes of the characters of the genera Ostrea, Plicatula, Placuna, and Anomia. It may be regarded as the connecting link between the two latter. With an arrangement of the hinge approaching very nearly to that of Placuna, it has the distinguishing organization of Anomia, while the external appearance of the shell, especially if viewed in situ, bears the strongest resemblance to Plicatula or some of the plicated oysters. The organ of adhesion, which in its bony character (for it is more bony than shelly) resembles that of Anomia, does not perforate the lower valve directly, but is inserted between the laminæ of the internal surface of the lower valve, above the muscular impression and below the hinge, and passes out into an external, irregular, somewhat longitudinal superficial fissure or cicatrix, which is narrowest at the hinge margin, and which it entirely fills to a level with the surrounding surface of the shell." (Broderip, 'Zool. Proc.' February, 1832.)

The Placunanomiæ appear to be widely distributed; they inhabit the seas of warm climates in both hemispheres. Mr. Broderip has described four ('Zool. Proc.' and Müller's 'Synopsis') brought to this country by Mr. Cuming, from the West Indies, Central America, and other western localities. They were dredged from sandy mud and muddy bottoms, adhering to bivalve shells, dead and living, and dead coral, at depths of six, eleven, and seventeen fathoms; of these, Placuna echinata wears something of the appearance of the short-spined Spondyli. Besides the species above alluded to, Mr. Broderip states that Mr. Sowerby furnished him with an odd valve of a large species from Luconia, which was beautifully iridescent internally; but as it was believed that this was identical with the fine shell sold by him to the British Museum, Mr. Broderip left the description of it to the officers of that establishment. Mr. Sowerby had some other odd valves, which Mr. Broderip thought might prove new, and the latter possessed two or three specimens adhering to Spondyli, from an unknown locality; but they appeared to be young, and though he was inclined to think that there was a new species among them, he deemed it prudent to wait for further information.

M. Deshayes remarks that this genus establishes the passage between Placuna and Anomia, and that it shows that the V-shaped tooth of Placuna is only an extreme modification of the large callosity of the Anomiæ; he adds that a fossil shell found in Egypt, and which has been taken for a Placuna, is a new step, as regards the hinge, between the Anomiæ and Placunæ.

2880.—Cuming's Placunanomia

(*Placunanomia Cumingii*, Broder.). In this species the shell is somewhat rounded, and the margin is plaited; the figure flattened; the general colour is white obscurely silvered. Length two and a half inches; height two inches and three-quarters.

It is a native of the shores of Central America (the Gulf of Dulce, province of Costa Rica), and was dredged up by Mr. Cuming at the depth of eleven fathoms, attached to dead bivalve shells and dead coral.

Referring to Fig. 2880, *a* exhibits the internal appearance of the organ of adhesion; *b*, the same seen externally.

We now turn to the genus Anomia.

In this genus the mollusk is very compressed in form, and has the edges of the delicate mantle fringed with a row of tentacular filaments. The foot is rudimentary. The adductor muscle is divided into three branches, and the largest of these passes by a notch in the lower valve, and becomes attached to an opercular stony or corneous piece, which is fixed to marine substances, as rock or dead shells; in this singular manner is the anomia moored.

The shell thus attached by its opercular piece, is inequivalve, irregular in outline, delicate, and often translucent. The fixed valve is the most flattened, having a round or oblong notch near the umbo, through which passes the muscular slip crowned with its opercular apex; the other valve is larger and more convex. The hinge-ligament is short and thick. The muscular impression is divided into three portions.

The Anomiæ occur in the European seas and the Atlantic Ocean: M. Deshayes in his tables records ten living species—eight species in tertiary formations, and two species found both in a recent and fossil state. It is one of the latter that we select for our example.

2881.—The Saddle Anomia

(*Anomia Ephippium*). This species is of large size; it is found in the British Channel, the Mediterranean, and the Atlantic Ocean. *a* represents the shell with the valves closed; *b*, the shell open to show the hinge; *c*, the hinge of the attached valve without the bony appendage.

Fig. 2882 shows the bony appendage of Anomia Ephippium: *a*, the bony part that goes through the opening of the shell; *b*, the surface which is attached to external objects.

Fig. 2883 represents a species termed by M. de Blainville Anomia squamata, which has not this additional bony appendage, and which he says is attached to objects by the valve itself. Mr. Sowerby supposes it to be the Anomia Ephippium in a very young state, before the appendage is ossified.

Family SPONDYLIDÆ (SPINY OYSTERS, WATER-CLAM, &c.).

According to M. Deshayes, the family Spondylidæ contains two genera, viz., Spondylus, into which he merges Podopsis, Dianchora, and Pachytes; and Plicatula, which indeed stands only on uncertain grounds, agreeing with Spondylus in all essential characteristics. In the Spondyli there are auricles, or angular processes, on each side of the hinge; and the umbo of the great valve is produced into a projection having a flattened surface divided by a furrow in which the old traces of the ligament may be perceived: on the contrary, in Plicatula the auricles rarely exist, and where they appear, are small, and there is no projection (talon) of the umbo; yet do the two genera merge insensibly into each other, for in some species of Spondylus the talon is trifling and without furrow, and the ligament is entirely concealed, as in Plicatula; while, per contra, in some species of Plicatula there is an approximation in the development of the umbo to that of Spondylus. Plicatula must in fact be regarded only as a convenient subgenus of Spondylus.

In the genus Spondylus the characters may be summed up as follows:—

Shell unequivalve, adhering to external objects; auriculated, beset with spines or rough; the umbones unequal; the lower valve offers an external cardinal (*cardo*, a hinge) facet, which is flattened and divided by a furrow, and which increases with age. Hinge furnished with two strong teeth in each valve, with an intermediate fosset for the ligament, communicated by its base with the external furrow. The ligament is external, and its old and useless remains show themselves externally in the furrow.

The mollusk is rounded or oval, its thickness varying in the different species. The two lobes or laminæ of the mantle are disunited at their edges, excepting along the short extent of the dorsal border corresponding to the hinge; their margin is thick and furnished with several rows of long fleshy cilia, between which and on the internal border may be observed a certain number of cilia at irregular distances, truncated as it were in the middle, and terminated by a smooth, convex, coloured surface, calling to mind the ocular surface of the tentacles in the snail. The branchiæ resemble those of the Pectens. The adductor muscle is large and circular. The mouth is situated at the anterior commissure of the mantle, and surrounded with a large slashed lip, fringed on the edge and accompanied on each side by a pair of palps, but little elongated, in the form of myrtle-leaves.

At the anterior part of the animal is seated a peculiar organ: it consists of a disc supported by a short pedicle; from the centre of this disc emerges a cylindrical tendon, terminated by a small, oviform, fleshy mass. This is evidently a modification of the foot, which, as it is not needed in the fixed Spondylus as a locomotive organ for the purpose of changing the place of the animal, is probably rendered subservient to the direction of the ciliary currents charged with food to the mouth.

Cuvier says the Spondyli are eaten like oysters; their shells are often tinged with lively colours. They are inhabitants of the Mediterranean and the warmer seas, and are found attached to corals, rocks, dead shells, &c., at depths varying from the surface to seventeen fathoms. Several splendid species are natives of the intertropics. An eminent conchologist, whose means of observation have been very extensive, makes the following interesting remarks: he says, every one must have noticed the spines with which the Spondyli are armed, and which in some instances are very long, bristling out on every side from the upper valve. "The lower valve is attached and adheres to submerged bodies by means of foliations. If the whole lower surface adheres, as it often does, not a spine is given out from the lower valve; but where the adhesion takes effect towards the anterior part of the lower valve only, as is frequently the case, especially when the shell is affixed among the branches of corals, a favourite locality with some species, the foliations are confined merely to that part where adhesion is required, and the rest or free part of the valve is as profuse of spines as the upper valve itself. There are two points to be gained—support or adhesion, and defence. The first is of primary importance; and as soon as that is safe, all the resources of the animal seemed to be turned towards the offensive and defensive armour. Those fishes which browse among the corals are thus deterred from injuring the living fixture which has there taken up its abode. A very fine series of specimens was collected with a view to this habit, and they showed not only the power which the animal had, of secreting the proper process of shell, according to the circumstances required, but of modifying the secretion according to the exigencies of the occasion."

2884.—The Ducal Spondylus

(*Spondylus ducalis*). In this example of the present genus the internal surface of the valves is displayed, showing the hinge, ligament, muscular impression, &c.: *a*, the upper valve; *b*, the lower.

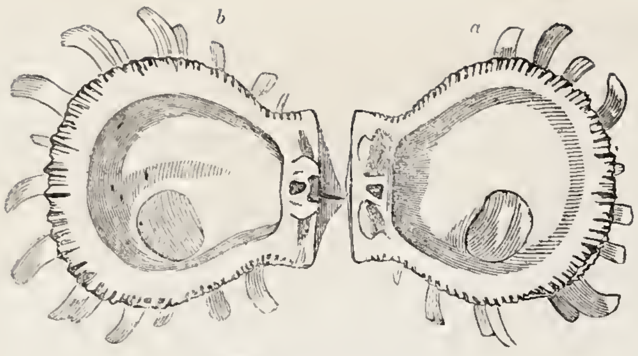
2885.—The American Spondylus, or Spiny Oyster

(*Spondylus Americanus*). In this example the valves are closed, with the umbones towards the spectator.

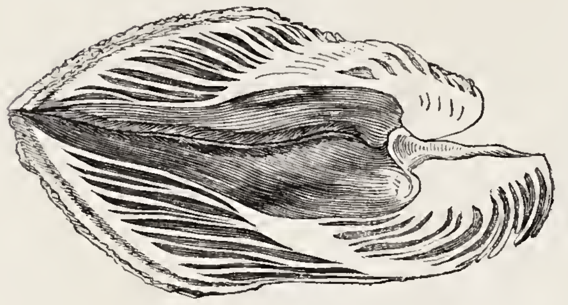
Fig. 2886 represents a section of the large spondylus, or Water-clam (Spondylus varius, Brod.), the valves of which are remarkable for the nacreous layers forming a series of hollow chambers or reservoirs, filled, many of them, with fluid. In young shells these chambers are not formed, but only in those of an advanced period of growth. The water can not only be heard trickling as the position of the shell is changed, but distinctly seen through the last transparent nacreous layer, forming the immediate bed of the mollusk.

On this camerated structure a valuable paper by Professor Owen will be found in the 'Proceeds. Zool. Soc.' 1837, p. 63, et seq. The following is part of that communication:—

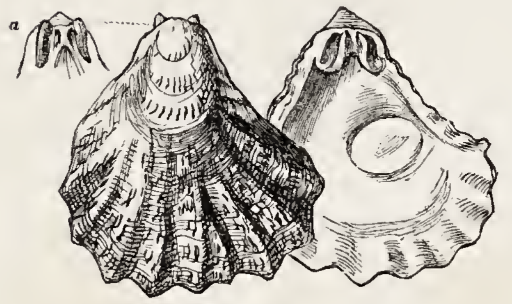
"In order to examine this camerated structure, and more especially to see how it was modified by the presence and progressive change of place of the adductor muscle, I had a fine specimen sawn through vertically and lengthwise. The specimen in question measures eight inches in length; and the substance of the concave valve, which is two inches one-third in thickness at the thickest part, includes fourteen chambers, separated from each other by very regularly formed and stout partitions, composed, as in other chambered shells, of the nacreous portion or constituent of the shell. The septa (or divisions) are slightly undulating in their course, but present a gradual concavity towards the outlet of the shell. Not any of these partitions, however, are continued freely across the shell;—but each becomes continuous at the muscular impression, which is near the middle of the shell, with the contiguous septa.



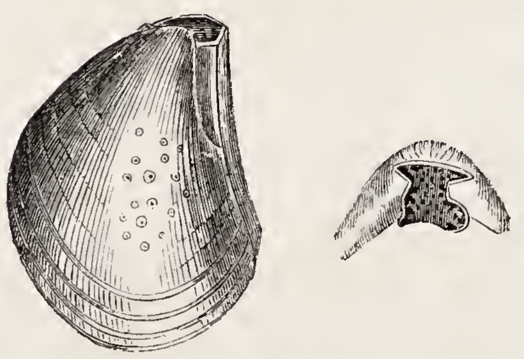
2884.—Ducal Spondylus.



2886.—Section of Water-Spondylus.



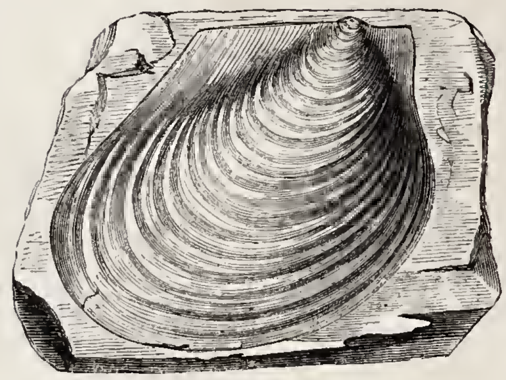
2887.—Plicatula.



2888.—Dianchora striata.

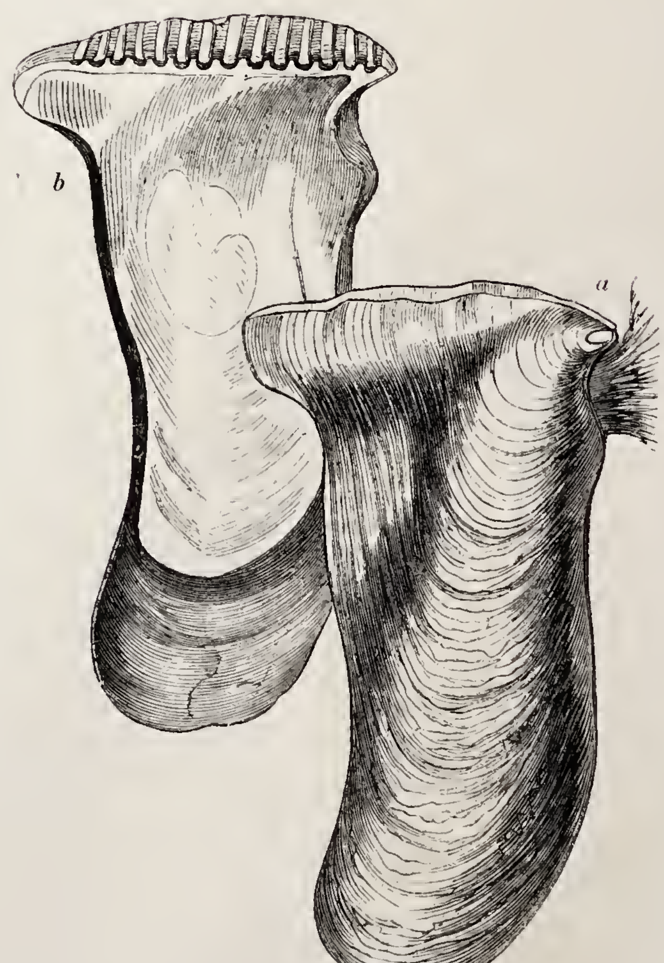
2885.—American Spiny Oyster.

2890.—Vulsella lingulata.



2889.—Possidonia.

2891.—Crenatula aviculoides.



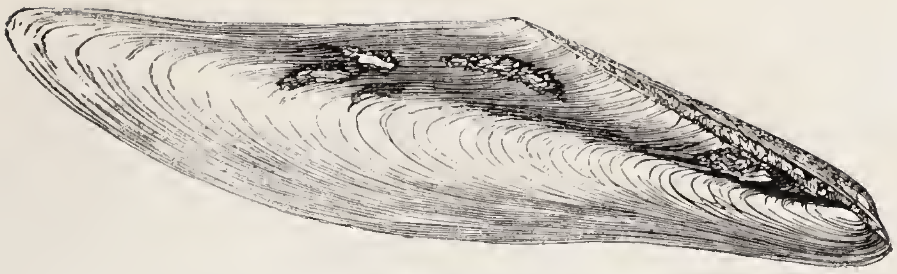
2892.—Perna Isognomum.

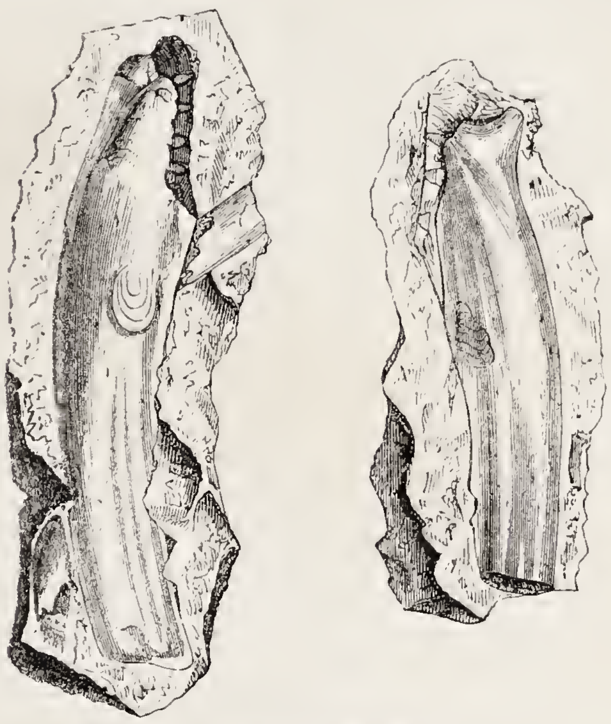
2893.—Hammer headed Oyster.

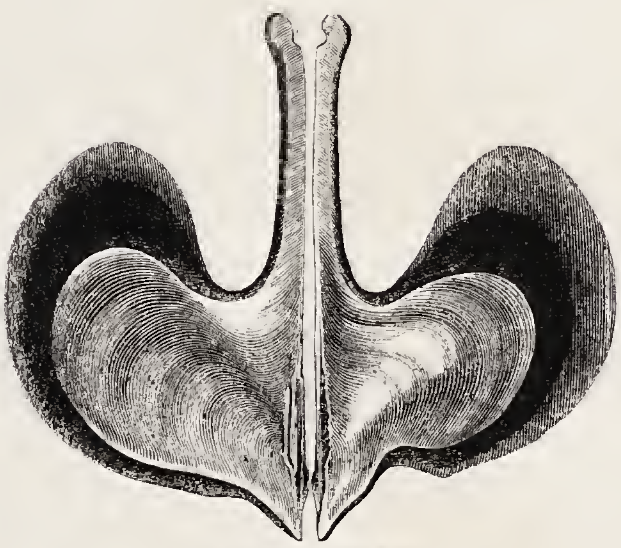

2894.—Inoceramus sulcatus.

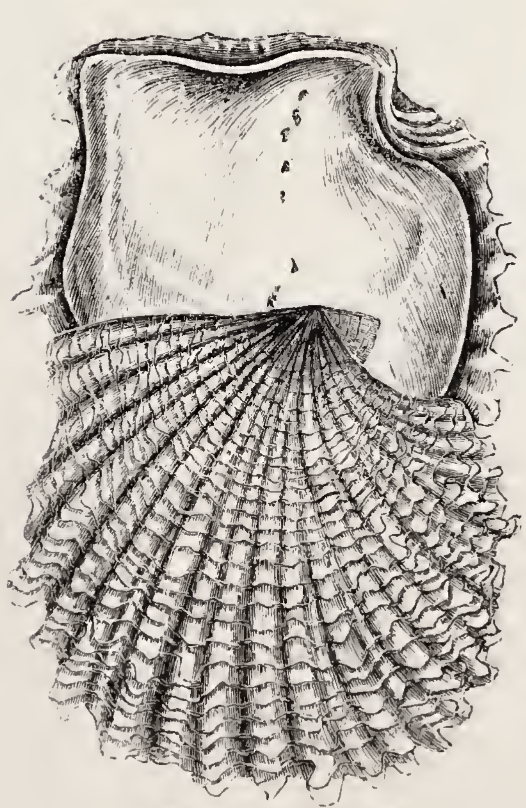

896.—Pluvinites Adansonii.

2895.—Catillus Cuvieri.


2897.—Gervillia aviculoídes.


2898.—Gervillia solenoídes.


2899.—Broad-winged Avicule.


2900.—Pearl-Oyster: Young.

In general also the septa commence singly from the cardinal or hinge wall of the valve, and divide into two when about one-fourth the way towards the opposite or lower wall; the thickness of the undivided part of the septum being equal to or greater than that of the two divisions or layers into which it splits.

"We can readily understand why the septa must necessarily become united together at the point of insertion of the adductor. The muscle never quits its attachment to the valves; while the lobe of the mantle, except in its circumference, and where it is attached to the adductor muscle, must detach itself from the surface of the valve which is about to be partitioned off, when it secretes upon the superimposed fluid the new septum, or basis of support. It is obvious, therefore, from the conditions under which the partitions are successively secreted, that they must adhere not only to the circumference of the valve, but to the preceding and succeeding septum, at the part occupied by the adductor muscle, and for an extent corresponding to its circumference. The progressive change in the position of this muscle, by the absorption of the posterior fibres, and the addition of others anteriorly, changes in a corresponding degree the relative position of these subcentral confluent parts of the septa, and a beautiful undulated disposition of the whole chambered part results. If the adductor muscle were a tube, instead of a solid mass, the central confluent part of the septa would of course be perforated, and a siphon would result, the calcareous walls of which, from the proximity of the chambers, would no doubt be continuous, as in many fossil *polythalmous* shells.

"A disposition is manifested to form chambers, though in a much less degree, in the smaller flattened or superior valve of the water-spondylus. In the specimen here described there are three chambers, with narrower intervals and much thicker partitions than in the lower valve. The secreting power of the lower lobe of the mantle in the spondylus is greater than in the upper; and the layers of nacre which are successively deposited on the cardinal margin push forward in a corresponding degree the upper valve, leaving a heel or umbo behind the hinge of the lower valve, which, from the inactivity of the secreting surface of the upper lobe of the mantle, is not opposed by a corresponding umbo in upper valve." After further details Professor Owen observes that "the interspaces of these successive layers of the growing spondylus cannot, from the absence of a medium of intercommunication, serve any purpose hydrostatically with reference to locomotion: it is a singular fact, indeed, that the spondylus, in which the chambered structure is constant, and the ostrea and other bivalves, in which it is occasional, are cemented to extraneous bodies by the outer surface of the shell, generally by the concave valve, so that the septa must be regarded as mere dermal exuviæ, still left adhering to the animal, to which, as a motionless bivalve, they are no incumbrance. It is highly probable that all the chambers are originally filled with fluid, as more or less is found in the outer ones of the specimens brought to this country."

The fluid, as analyzed by Dr. Bostock, when poured off from a curdy sediment, consisted almost entirely of a solution of pure muriate of soda, with a brown precipitate, to which its peculiar rank flavour and odour were most probably owing. The sediment appeared to be of organic origin.

Fig. 2886 represents the section of a very old individual, in which the upper shell was very convex, and much more numerously camerated than the specimen described by Professor Owen. We need not add that till death the number of these septa and chambers is perpetually increasing.

We now turn to the subgenus Plicatula, in which the shell is inauriculate; the upper border rounded and subplicated, with unequal umbones and without external facets: hinge with two strong teeth in each valve: a fosset between the teeth receives the ligament, which is entirely internal.

In our example of Plicatula, Fig. 2887, *a* represents the hinge of the upper valve, with the two teeth.

In its distribution and habits Plicatula does not differ from Spondylus.

The recent species of Spondylidæ are numerous, but the fossil species are very much so, and have a wide geological distribution, from the chalk and oolitic beds, to the various tertiary deposits.

Before leaving the family Spondylidæ, we may revert to the fossil genus termed Dianchora by M. Sowerby, in his 'Mineral Conchology.'

The different situations in which this genus has been placed seem to indicate that some doubt as to its affinities exist. Cuvier, in his 'Règne Animal,' places it between Pachytes and Podopsis; M. de Blainville, between Plagiostoma and Podopsis; and M. Rang, between Pecten and Pedum.

M. Deshayes, in his edition of Lamarck, observes that Pachytes (fossil) had been formed at the expense of Plagiostoma (fossil), and goes on to state that, from an examination of the species, he was convinced of the identity of those two genera; and moreover that an investigation of the characters of Dianchora proved to him that they were identical with those of Pachytes and Podopsis. A still further inquiry terminated in the conclusion that the so-called fossil genera Podopsis, Dianchora, and Pachytes were only Spondyli whose internal lamina had been dissolved, the external or conical lamina being thus left naked.

The characters of the fossil shells attributed to Dianchora may be easily perceived by a reference to one of the so-called species (Dianchora striata) selected by way of example (Fig. 2888).

The general characters of Plagiostoma, Sowerb.; Pachytes, Defr.; Dianchora, Sowerb.; and Podopsis, Lam. may be seen in Cuvier's 'Règne Animal,' vol. iii. p. 124-5.

Family MALLEIDÆ (HAMMER-OYSTERS).

In this family, the shell, generally of a black or dusky horn colour, is inequivalve, inequilateral, and very irregular; the hinge is without teeth; the marginal ligament is sublinear, simple, or interrupted by crenulations, the muscular impression subcentral; the shell is generally fixed by a byssus proceeding from the animal. The mollusk has the mantle open without tube, and prolonged into irregular lobes. The foot is channelled, and almost always furnished at its base with a byssus.

At the head of this family M. Rang places the fossil genus Possidonia: he characterizes the shell as being very delicate, nearly membranous, equivalve, but inequilateral, oblique, and rounded. The cardinal border is straight, but a little produced on each side, so as to be auriculated. Hinge toothless. No pit for the ligaments: no passage for a byssus. This form occurs in the schists of Dillenberg. The specimen, Fig. 2889, is from the Irish limestone. M. Deshayes, in his last edition of Lamarck (1836), does not enumerate Possidonia as one of the Malleidæ or Malleacea.

From this somewhat indeterminate fossil form we turn to the genus Vulsella, of which the species are all peculiar to warm climates; none of them appear to be furnished with a byssus: they are found amidst Alcyonia, sponges, and other Polypifera. The general form of the shell is seen in the specimen of Vulcella lingulata, a native of the Indian Seas (Fig. 2890.) In structure the shell is somewhat horny and delicate; the hinge is toothless, and offers simply on each valve a projecting callosity, in which is a pit for the insertion of the ligament. The muscular impression is subcentrical. At Fig. 2890, *a* shows the valves closed; *b* is an inside view, showing the hinge and muscular impression.

The mollusk is elongated and compressed; the mantle bordered with two rows of close-set tubercles. The foot is small and channelled; the mouth is large, the labial appendages much developed and triangular; branchiæ long and narrow.

From this genus we advance to an allied genus, viz. Crenatula, of which the mollusk does not appear to be known; like the Vulsellæ, the Crenatulæ inhabit the warmer seas, namely, those of the East Indies, New Holland, and South and Central America, where they are found in sponges, &c., but are neither fixed by their valves nor moored by a byssus.

The shell is foliated, flattened, subequivalve, inequilateral, and irregular: a little gaping behind, but without any aperture for a byssus. The hinge is linear and marginal, and marked with crenulations which are callous and hollowed into rounded pits for the reception of the divisions of the ligament. Muscular impression subcentral. Fig. 2891 represents the Crenatula aviculoides. The genus Perna next claims our notice.

The species belonging to this genus are all natives of the warmer seas, and particularly those of the East Indies; some, however, occur in the seas of the Antilles, at Cape Verd, and the Azores. They are furnished with a strong byssus, by means of which they are moored to rocks, and the roots and trunks of mangrove-trees growing at the water's edge; and they appear to range in depths from the surface to eight or ten fathoms: the shell is black or dark horn colour, lamellar, very much flattened, subequivalve, inequilateral, and very irregular; the hinge is straight and marginal, having on each side a row of small parallel furrows, which are transverse, and in which the divisions of the ligaments are inserted; the muscular impression is subcentral.

The animal is compressed; the foot is small, with a byssus at its base.

Fig. 2892 represents the Perna Isognomum, a native of the Indian seas: *a*, the valves closed, showing the byssus; *b*, an inside view of a valve, showing the hinge and muscular impression: though in the crenulations or pits of the hinge the genus Perna approaches Crenatula, yet in general form and in presence of the byssus it more closely approximates to the typical genus of the family, viz. Malleus, or the Hammer-headed Oysters.

In the genus Malleus the shell is foliated, black or corneous, and of a somewhat nacreous texture; the valves are subequal, the form irregular, often auriculated, and presenting a hammer-shape or that of the letter T. The umbones approximate, and before them is a notch for the passage of a byssus. The hinge is linear, very long and toothless, with a conical oblique pit, partially external for the reception of the ligament, which is triangular and subexternal. The muscular impression is of considerable size and nearly central.

The mollusk is compressed, with a fringed mantle prolonged backwards; the foot is distinct and channelled, with a byssus springing from its base.

The Mallei are natives of the seas of the East and West Indies, and of Australasia. They are found generally at or near the surface, to six or seven fathoms; but according to M. Rang, the species from Guadaloupe and Martinique occur at great depths. They are moored by the byssus to submarine rocks and other bodies. The species are not numerous, but as two specimens seldom agree in shape, the genus at a cursory glance might seem to be very extensive. M. Deshayes states that he never saw two individuals of the same species alike. Age effects great difference in their shape, and especially in that of the auricles of the valves. From this circumstance some yet regarded as species may prove to be only the young of others.

The example selected is the Common Hammer-headed Oyster (Malleus vulgaris), from the Indian and South Seas. Fig. 2893: *a* exhibits the shell with the valves closed; *b*, the inside view of a valve, showing the hinge and muscular impression.

We now pass to a singular fossil form, referred to this family, viz. the genus Inoceramus, Sowerby, in which the shell is characterized as gryphoid, that is, with incurved umbones, inequivalve, irregular, subequilateral, with a lamellar shell pointed anteriorly] and enlarged at its base. The umbones are incurved towards the hinge, which is short, straight, and narrow, with a series of crenulations gradually decreasing for the reception of a multiple ligament. Several species of this form occur in the chalk, two in the chalk marl, two in the gault, one in the lower green-sand (Shanklin), &c.

The species Inoceramus sulcatus, Fig. 2894, selected as our example, is from the blue marl of Folkstone. The larger figure is of the natural size; the smaller shows the hinge of one valve, the other valve being an inside cast.

Another genus known only in a fossil state is Catillus, of which the specimen selected (Catillus Cuvieri) at Fig. 2895 is a good example. With others of the genus it occurs in the white chalk of England and France. Some of the Catilli in past ages attained an enormous size, specimens having been found measuring several feet in length.

The hinge of the shell in this fossil genus has its border furnished with a row of small cavities, represented at *a*.

Among the fossil form of the Malleidæ may be enumerated Pulvinites. The shell is delicate, subequilateral, with the umbones inclined a little forwards. The hinge presents eight or ten divergent teeth, forming so many pits. The impressions of this form occur in the chalk. We select the Pulvinites Adansonii, Defr., Fig. 2896, as an example.

To the Malleidæ most conchologists refer the genus Gervillia, like the preceding found only in a fossil state. This fossil form was first characterized by M. Defrance, from a species in the baculite limestone of Normandy, under the above title, from M. de Gerville, who originally detected it.

It would be out of place were we to follow out in detail the opinions of different naturalists respecting the affinities of Gervillia, but referring to the first vol. of the 'Zool. Journal,' in which these opinions are discussed, we observe that the writer of the article is disposed to regard the Gervilliæ as having the nearest affinity to the Pernæ, from which they may at once be distinguished by possessing an apparently inner additional hinge, formed of several oblique teeth, variously disposed according to the species.

Mr. Sowerby considers Gervillia to be intermediate between Perna and Avicula; Cuvier gives it ('Règne Animal') as a subgenus or section of Perna.

The shell is oblong, nearly equivalve; very inequilateral, and oblique. The hinge is long and linear, nearly straight, with many irregular and somewhat transverse little pits, and teeth placed below the dorsal edge. A better idea, however, will be conceived of the general form of the shell by referring to our selected examples: Fig. 2897 represents Gervillia aviculoides; Fig. 2898 represents the Gervillia solenoïdes.

This genus occurs through various strata upwards from the lias to the baculite limestone of Normandy, and consequently existed through several geological periods: specimens are found in the green-sand or cretaceous group, and in the oolite.

The families or groups which we have hitherto

contemplated, from the Pectinidæ to the present, are included by Cuvier under his great section Les Ostracés; and here, then, ends the *Monomyarian* subdivision of it.

The succeeding genera, belonging to the Ostraea, and indeed, generally speaking, all the following groups or families of Bivalve Mollusks, are *Dimyarian*, excepting Tridacna.

DIMYARIA.

Family MELEAGRINIDÆ (PEARL-OYSTERS, &c.).

Under the comprehensive genus Avicula Cuvier includes two sections: one, the Pearl-Oysters, Meleagrina, Lam. (Margarita, Leach); and the restricted genus Avicula, Lam., of which the Mytilus Hirundo of Linnæus, a native of the Mediterranean, and the Avicula macroptera, are examples.

To the genus Avicula Mr. Sowerby also refers the genus Meleagrina of Lamarck; regarding the distinctions between them as of trivial importance. The shell in both is foliacious externally, and internally of a brilliant pearly lustre. The left-hand valve is contracted and notched posteriorly, and so is the right, but very slightly. Through the sinus thus formed passes the byssus, by which the shells are moored to rocks and stones. The ligamental surface is marginal and broadest in the centre; and there is generally a small tooth in each valve near the umbo. Generally this tooth is most conspicuous in Avicula, but is not always found; whilst in Meleagrina it is, on the other hand, often apparent, though sometimes absent. The muscular impression is nearly central, somewhat circular and large.

As thus characterized, Avicula will comprise two sections, namely, one in which the species have the hinge-line considerably prolonged—Avicula of Lamarck; the other comprising such species as are without that prolongation—Meleagrina of Lamarck.

Cuvier thus defines Avicula (Les Arondes):—The shell has the valves equal, with a rectilinear hinge, and is often carried out into wings; the ligament is narrow and elongated; small dentilations often appear on the hinge, on its anterior part; and below the angle on the side near the mouth is the notch for the byssus. The anterior adductor muscle is still extremely minute.* Those species are termed Pintadines (Meleagrinæ) which have the auricles but little salient. The term Avicula is reserved for those in which the auricles are more pointed and the shell is more oblique: they have on the hinge before the ligament the vestige of a tooth at least, of which scarcely any trace is perceptible on the Pintadines.

As the two so-called genera thus stand, it may be at least convenient to consider them separately, under a family title; for even if it be deemed unphilosophical to retain the two genera, still Avicula seems to be the type of a family form.

2899.—THE BROAD-WINGED AVICULE

(*Avicula macroptera*). This shell, of which the valves are represented open so as to display the hinge, will convey a better idea of the general characters of the genus than any verbal details. These shells, as those also of the genus Meleagrina, are natives of the warmer seas, where they moor themselves at various depths to the surface of rocks, old shells, and other submarine objects.

2900.—THE PEARL-OYSTER

(*Meleagrina Margaritifera*). Mytilus Margaritiferus, Linn.; Avicula Margaritifera, Sowerby.

Our pictorial specimen of this interesting shell is that of a young, or at least not aged specimen; it is marked with beautiful foliations, which disappear when the shell has attained to a large size.

The valves are semicircular, greenish externally, and lined internally with a layer of the most beautiful nacre. From the size of the ornaments made of this nacre, or mother-of-pearl, some idea of the magnitude attained by the shell may be appreciated. Were it only for the production of this article, so much in request for all kinds of "bijouterie," this shell would form an important object of commerce; but yielding as it does its nacreous lining in such abundance and solidity, it affords also those more valued nacreous drops or nodules called pearls, estimated in the East, time immemorial, as "of great price"—the ornaments of kings.

Pearls are procured in both hemispheres. In the Old World, the Gulf of Persia, the west coast of Ceylon, and the coast of Coromandel are the chief pearl-stations. The Algerine coast and the Sooloo Islands also afford these treasures.

In the New World, the neighbourhood of St. Margarita, or Pearl Island, and other localities along the coast of Columbia, are noted, and the Bay of Panama also produces them. The fisheries on the coast of Columbia must indeed once have been valuable, for Seville alone is said to have imported upwards of 697 pounds in the course of the year 1587. Philip the Second's celebrated pearl, which weighed 250 carats, and was valued at 150,000 dollars, came from St. Margarita. Yet the pearls of the West are not to be compared with those of the East in shape, beauty, colour, or texture. We are not aware that any established fishery is now conducted at St. Margarita, or on the coast of Columbia on an extensive scale, after the failure of the Columbia and Panama speculation in 1826.

On the contrary, the pearl fisheries of the Gulf of Persia, of Ceylon, and Coromandel, are still actively prosecuted during the appointed seasons.

Cuvier, in his 'Règne Animal,' places in close contact with Avicula and the pearl-oysters the genus Etheria of Lamarck, and which writers regard as belonging to the Chamidæ. M. de Blainville, M. Deshayes, and Mr. Broderip, however, all agree that the Etheriæ ought to be separated from the Chamidæ; and M. de Blainville considers them as coming within the pale of the Margaritacea, or family of pearl-oysters.

Lamarck regarded the Etheriæ as oceanic, and accounted for those shells having escaped the notice of zoologists on the presumption that they were attached to rocks at great depths. The first conchologist who ventured to doubt this, and to suspect them to be fluviatile, or at least the inhabitants of estuaries at the mouths of rivers, was Mr. G. B. Sowerby; his opinion has been confirmed by M. Cailliaud, who was the first to make known the fact that the genus is an inhabitant of fresh waters. From M. Cailliaud's materials M. de Férussac published a paper in the 'Mémoires de la Société d'Histoire Naturelle,' vol. i., including a revision of the species.

M. Rang, during a voyage to Senegal, made some interesting observations on the Etheriæ which live 200 leagues from the mouth of the river of Senegal, and, together with M. Cailliaud, who received the animal from the Nile, published a memoir ('Mémoires du Muséum d'Hist. Nat.') replete with information, in which the mollusk was for the first time described.

The rivers of Africa and Madagascar appear to have afforded all the specimens, still by no means common in cabinets, which have hitherto been collected.

M. Férussac gives the following information from M. Cailliaud:—

"We meet with Etheriæ," says that zealous traveller, "after passing the first cataract, and they do not appear to exist below; they become very abundant in the province of Rebata, and below the peninsula of Meroe. The inhabitants collect them on the banks of the river, to ornament their tombs with them, and they say that they come from the more elevated parts of the Nile, from Saïda, where they are eaten." M. Cailliaud found them as far as Fazoql, the most distant country into which he penetrated from the Blue River.

In Sennaar the inhabitants informed M. Cailliaud that during the summer season, when the river was low, they took them with the animal; but notwithstanding all his endeavours, M. Calliaud could not obtain any living specimens, the river being then always too high. They are said to be common in the Jaboussi, a river which runs into the Blue River, and in all appearance the numerous confluent streams of this great arm of the Nile produce them also. The number found upon the tombs throughout Ethiopia is so great, that it is astonishing that Bruce and Burckhardt should not have mentioned them. (See 'Zool. Journ.' vol. i.)

M. Deshayes, in his treatise on the genus, in the 'Encyclopédie Méthodique,' states that individuals of the same species adhere by the one or the other valve indifferently, which is not the case either in the oyster or the Chamæ. The Chamæ, however, as has been observed by Mr. Broderip, are found to be attached sometimes by the right and sometimes by the left valve.

The shell of Etheria is characterized as thick, nacreous, adherent, very irregular, unequivalve, and inequilateral. The umbones are short, thick, and indistinct; the hinge is toothless, irregular, undulated, and callous; the ligament is longitudinal, tortuous, external, and penetrates pointedly into the interior of the shell. The muscular impressions are oval and irregular; pallial impression narrow and small.

The mollusk is described as closely resembling unio. The lobes of the mantle are disunited and without siphons. The mouth is rather large, with a pair of palps, as in unio; and, what is singular in an animal which lives adherent to foreign substances, it is provided with a very large foot, which may be compared, in regard of its form and position, with that of unio. May not this large foot have reference to the acquisition of food?

2901.—THE SEMILUNATE ETHERIA

(*Etheria semilunata*). The species of the genus Etheria are at present in some degree of uncertainty. Lamarck records four: these M. Férussac and M. Deshayes reduce to two; and M. Rang considers E. Tubifera of Sowerby and E. Cailliaudii of Férussac as identical; and E. Cortoni of Michelin to be the same with E. Plumbea of Férussac. The variation in the form of the shell from age and other circumstances is so great, that were not this fact kept in view, each individual might be regarded as a distinct species. Even in the same species there are individuals armed with spines and others devoid of those appendages.

Family MYTILIDÆ (MUSSELS, *or Muscles*).

The family Mytilidæ, as here restricted, is equivalent to the first section of Cuvier's great group, which he terms Les Mytilacés; that is, it includes the genera Mytilus, Modiolas, and Lithodomus (Les Moules propres of Cuvier), to which we add the genus Pinna, although aware that the mantle has no posterior commissure, and consequently no siphon, and that Cuvier gives it as a typical form under his Ostraceans. Yet its approximation to the Mytilus cannot be overlooked, and if we are to attach an over-great importance to the existence of siphons, and their number, we must then establish Pinnæ as the type of a family in close contiguity to that of the Mytili. Leaving this point open, let us first direct our attention to the genus Mytilus, which includes that well-known species the Edible Mussel (M. edulis).

The genus Mytilus is abundant on most rocky coasts, where facilities are afforded for the species mooring themselves to reefs, stones, and other substances covered at high water, but left dry by the ebbing of the tide. To the byssus we have already alluded, and explained its mode of production: when the mussel is once moored, it does not, in the opinion of Mr. G. B. Sowerby, habitually disengage itself; though he admits that when torn from its anchorage by the force of the waves, it may live for some time without being in any manner affixed. It is not only on rocky shores that the mussel abounds, we have seen beds of mussels on low, flat, sandy, or pebbly shores, as for example on the low coast between Southend and Shoebury Point, Essex, where they greatly abound: numbers, as we observed, were totally free; others had their byssus attached to small shells, little pebbles, or fragments of shells mixed with sand, small stones, and the like; and certainly whole strata of these shells must in such situations suffer a greater or less change of place with an ever-flowing and retiring tide on a low flat shore left dry periodically over a wide extent of surface.

Of the figure and colour of the shell of the common mussel nothing need be said; but, with respect to the mollusk, few of the thousands who have eaten it know anything beyond its flavour. In form this mussel resembles that of its shell: the lobes of the mantle, adherent at their edge to the edge of the shell, are continued dorsally and open in front, but are united posteriorly in a single point, so as to form a short siphon, or orifice, for the passage of the ejesta. The mouth, in a sort of hood near the apex of the shell, is rather large, and furnished with two pairs of soft palps, pointed, and fixed by their summit only. The foot is slender, carrying at its base and posteriorly to it a byssus, known as the "beard." There are two adductor muscles: one at the apical part of the valves, small; the other situated posteriorly, large and rounded. Fig. 2902 exhibits the posterior part of the body of the common mussel, displaying some of the principal organs: A, right lobe of the mantle; D, portion of intestinal tube; G, branchiæ; H, foot; J, posterior muscle; L, superior tube; O, heart; P, ventricle; Q, auricle; X, pericardium; *b*, tentacles; *d*, byssus; *e*, gland of the byssus; *g*, retractile muscle of the foot; *h*, valves of the mantle; *i*, egg-duct; *j*, excretory orifice; internal ditto.

Fig. 2903 shows the form of the eggs of the mussel, magnified.

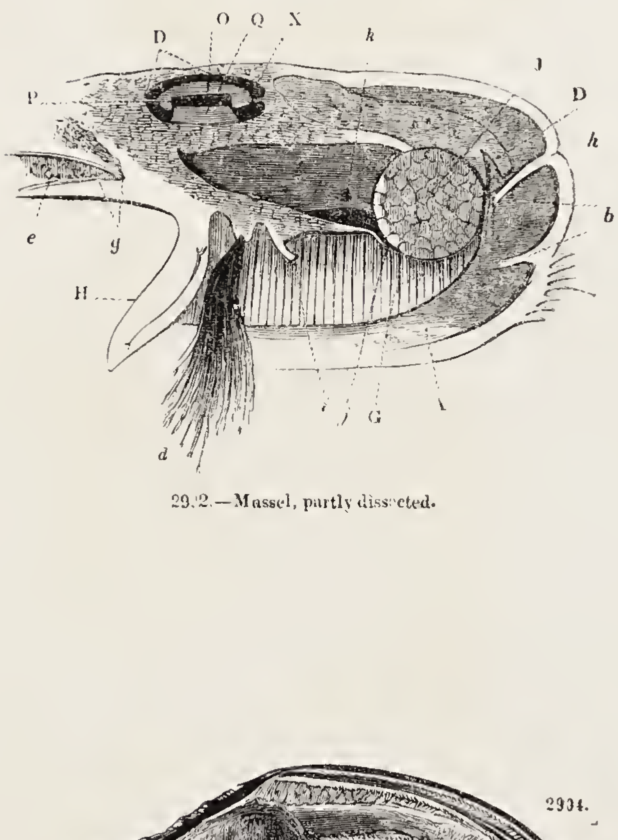
Fig. 2904 shows the mussel lying in a detached valve with the byssus; the lobe of the mantle covering the exposed surface is slightly contracted, showing the branchiæ.

Fig. 2905 exhibits the mussel, as seen when the shell is partially open; the byssus may be observed rising from the root of the foot posteriorly: the commissure of the mantle bounds the view behind, and in the space intermediate are the egg and excretory ducts, pointing to the short siphon produced by the commissure, where the great adductor muscle is also apparent. Figs. 2906, 2907, and 2908, also exhibit the common mussel: Fig. 2906, the shell with the valves closed and the byssus emerging; Fig. 2907, an internal view of one of the valves, showing the muscular impressions; Fig. 2908, an external view of one of the valves. The common mussel is known to produce minute pearls, called seed-pearls; and we have found two or three not unfrequently in a single shell.

We need not say that the mussel is gregarious,

* M. Deshayes states Avicula to be Monomyarian.

2901.—Semilulate Etheria.



2902.—Mussel, partly dissected.

2904.

2905.

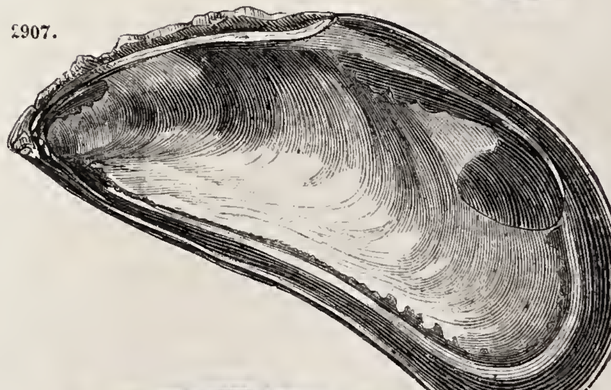
2904, 2905.—Mussel.

2903.—Ova of Mussel.

2909.—Magellanic Mytilus.

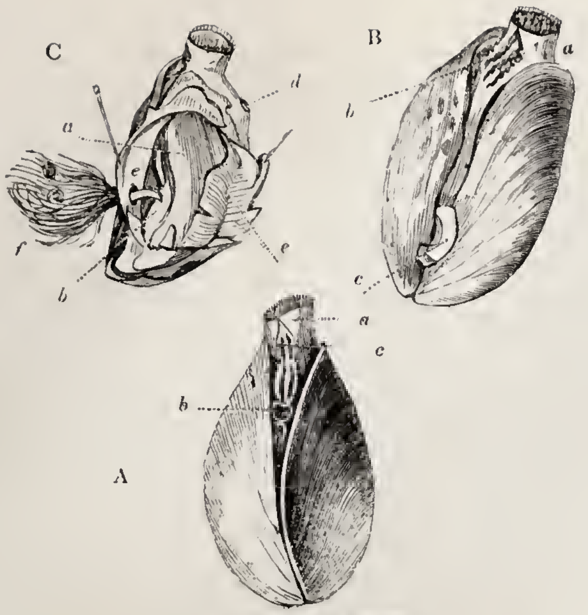
2906.

2907.

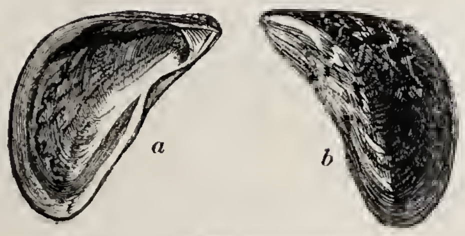


2908.

2906, 2907, 2908.—Shells of Mussel.



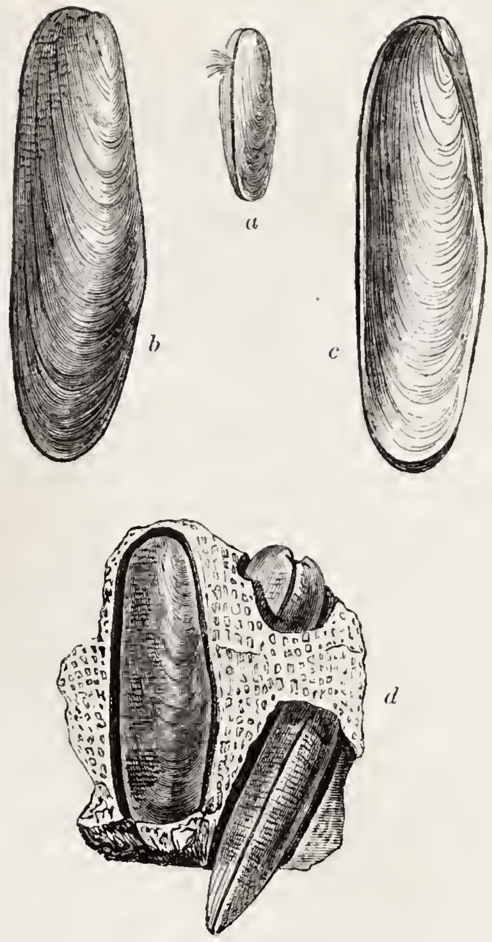
2910.—Dreissina polymorpha.



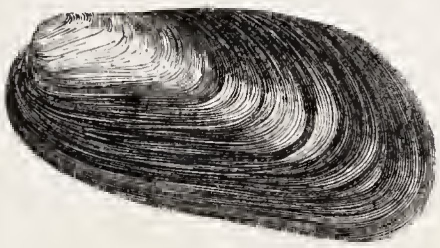
2911.—Shell of Dreissina polymorpha.

2912.—Sulcated Modiola.

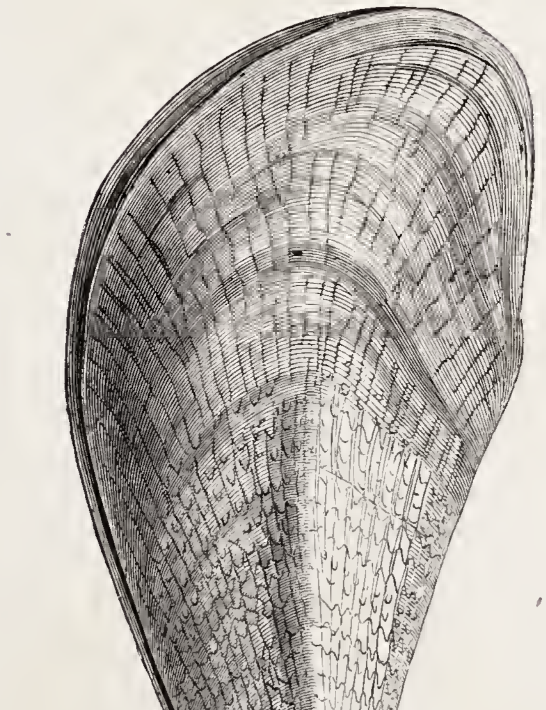
2915.—Pinna flabellum.



2914.—Finger Lithodomus.



2913.—Cinnamon-coloured Modiola.



2916.—Pinna flabellum.

occurring in beds which cover rocks and stones, generally between high and low water-mark, but often also at a greater depth. We have seen shells clustered over by these mollusks, and some time since had under our immediate notice a large live lobster, the back of which was densely covered by a phalanx of mussels in serried array, a circumstance to which, on other considerations, we shall hereafter revert.

We need not say that the mussel is extensively used as food, and by some exceedingly relished. It is however eaten by many persons with certain misgivings, arising from its supposed poisonous properties; some regarding the byssus as deleterious, while others have supposed that a little crustacean (Pea-crab) which at particular seasons shelters itself in the shell of the mussel, is the source of mischief. The fact is the mussel is by no means digestible, and that with some constitutions, or some temporary conditions of the digestive organs, it cannot be eaten with impunity. Several persons may partake of the same dish, and yet only one or two may suffer ill effects—which manifest themselves in flushings of the face, nausea, derangement of the system, often followed by blotches, rashes, swellings, spasmodic asthma, and other unpleasant symptoms. Similar effects occasionally follow a hearty meal upon crab, or even upon lobster; a phosphorescent lobster is poison. The most celebrated mussels are from Hambleton, a village in Lancashire; they are taken out of the sea, and placed in the river Weir within reach of the tide, and grow fat and delicate.

There is a fine species of mussel (Mytilus Choros, Molina) particularly noticed by Captain King among the shell-fish of the island of Chiloe. Molina, he says, has described the Choro (mussel) of Conception, which is not different from that of Chiloe. It is often found seven or eight inches long. The fish is as large as a goose's egg, and of a very rich flavour; there are two kinds, one is dark brown, the other of a yellow colour: but the last is most esteemed.

There is another sort also, much larger than the Choro, but equally delicate and good; the fish of which is as large as a swan's egg: it is called Cholgua, but as the shells seem to be of the same species, I think the distinction can be only owing to size. The manner in which the natives of these islands, both Indians and descendants of foreigners, cook shell-fish is similar to that used for baking in the South Sea Islands and in some parts of the coast of New Holland. A hole is dug in the ground, in which large smooth stones are laid, and upon them a fire is kindled. When they are sufficiently heated, the ashes are cleared away, the shell-fish heaped upon the stones, and covered first with leaves or straw, and then with earth. The fish thus baked are exceedingly tender and good, and this mode of cooking them is superior to any other, as they retain within the shell all their own juiciness.

Some of the Mytili have the shell striated longitudinally; as the following:—

2909.—THE MAGELLANIC MYTILUS

(*Mytilus Magellanicus*). In this species the shell is violet purple above, with long thick undulated furrows; inside whitish; length four or five inches. The shells of old individuals when polished are very brilliant and deeply tinted with purple, passing into rich violet.

This mussel is found in the Strait of Magalhaens, at Chiloe, &c. Its flesh is excellently flavoured and nutritious. The specimen is represented as attached to a rock by its strong byssus.

The next genus to be noticed is that to which Dr. Vanbeneden has given the title of Dreissina (from M. Dreissens of Mazeyk), of which the type is the Mytilus polymorphus of Pallas and Gmelin.

In this genus the mollusk differs from that of Mytilus, the mantle being far more extensively closed, with three apertures, one anterior and two posterior: of the latter the terminal aperture is larger than the other, and prolongs itself into a short siphon, destined to conduct the water over the branchiæ; the other aperture is placed more dorsally for the rejection of effete matters; the anterior aperture is for the passage of the byssus and the foot.

The shell exhibits three muscular impressions, and a septum internally at the umbo. The shell is of a more recurved form than we find generally in Mytilus; the Mytilus recurvus, however, of America, is regarded by Dr. Vanbeneden as its analogue.

Dr. Vanbeneden records two recent species, Dreissina polymorpha, and Dreissina Africana.

In their habits these species resemble the marine mussels; they form beds at the bottom of the water, adhering to stones, shells, rocks, &c.: numbers are often agglomerated together by means of their byssus in bunches, or to a stone or shell, which they entirely shroud. Their extent of range is considerable, their dispersion resulting from the circumstance of their attaching themselves to logs of wood, or the keels of vessels, by means of which they are transported from sea to sea.

Fig. 2910 represents the Dreissina polymorpha. A, the shell and animal of the natural size, with the siphon, *a*, exerted; and the more dorsal orifice also to be seen at *b*; *c*, the posterior row of papillæ. B, a view of the ventral side: *a*, the siphon; *b*, the anterior row of papillæ; *c*, the languette. C, animal in the left valve: *a*, the abdomen; *b*, the languette in situ; *c*, the branchiæ; *d*, the dorsal orifice; *e*, the aperture of the byssus; *f*, the byssus turned back.

The languette, it is stated, does not appear to be the true foot (which is muscular and serves as an organ of progression), but forms a part of the retractor muscle; and possesses no character in common with the foot except its mobility; at the base of this organ is the byssus—such is Dr. Vanbeneden's opinion. If this be not the foot modified, then the mollusk is destitute of such an organ; but the admission that it seems to explore bodies with this languette, would lead us to think that it was at least a substitute for that organ, which in the mussel is more developed.

Fig. 2911 represents the Shell of Dreissina polymorpha; *a*, the inside view of the valve, showing the septum at the umbo; *b*, the valve viewed externally, so as to afford a good idea of the general outline.

The Dreissina polymorpha is spread extensively through Europe and Asia. It inhabits seas, lakes, rivers, and marshes, all being alike congenial abodes. It is found in the Caspian Sea, the Black Sea, the Baltic, the rivers Danube, Wolga, and Rhine (abundantly), the marshes of Syrmia, the canal of Belgium (Canal Guillaume), the lakes of Holland, the Thames, the Lea, the Commercial Docks London, the Union Canal at Edinburgh, and many other localities. Mr. J. D. C. Sowerby, we are informed, was the first to notice the occurrence of this species in the Commercial Docks in the Thames, and he is of opinion that it was originally introduced adherent to shipping, logs of timber, &c.

We now advance to the genus Modiola (Modiolus of some authors).

This genus is separated from Mytilus upon somewhat unsatisfactory grounds, and principally because the umbones, instead of being pointed and terminal, are rounded and do not advance so far as the anterior margin of the shell, which is produced in a rounded form. Nevertheless, when a number of species, fossil and living, of both genera are assembled together, it will be found that the transition from genus to genus is so imperceptibly gradual that there is no possibility of determining the point when the one ends and the other begins. These observations equally apply to the transition between Modiola and Lithodomus, proving that the genera are artificial rather than natural.

Many of the Modiolæ live in stones, into the substance of which they bore their way, but by what means is not positively ascertained; others, however, moor themselves by a byssus. Mr. G. B. Sowerby observes that "the Modiolæ, like the Mytili and many other genera, affix themselves to submarine productions by means of a bundle of rather coarse fibres, commonly called a byssus, each fibre of which is fastened to the rock by its expanded external termination, and applied by the foot of the animal. The recent species of modiolus are not very numerous; we have, however, several on the coasts of Britain, of which the most remarkable are M. discrepans and M. discors." These two species are always found imbedded in the common ascidia (one of the Tunicata), and appear to be destitute of a byssus, while much larger specimens, brought from the West Indies, are found completely enveloped in a fine silky byssus, closely matted together and forming large bundles. Some cognate species, however, which have been brought from the Northern Ocean, appear, he adds, to have been affixed by a few filaments only.

2912.—THE SULCATED MODIOLA

(*Modiola sulcata*). This species represents a section in which the shell is sulcated longitudinally. It is a native of the Indian Seas. Hinge margin dentilated; shell bluish white; epidermis yellowish. *a*, the shell closed, with the byssus; *b*, outside view of valve; *c*, inside view of ditto.

2913.—THE CINNAMON-COLOURED MODIOLA

(*Modiola silicula*). This species, which according to M. Deshayes is identical with M. cinnamomea, is found in the seas of the Isle of France and of New Holland. The shell is of a maroon brown or whitish; the epidermis is deep maroon brown.

Most naturalists agree in the generic distinction of our next genus Lithodomus, Cuvier; the shell is delicate, covered with an epidermis, oblong, elongated, subcylindrical, and rounded anteriorly, but not gaping; the umbo is distinct, but surpassed by the anterior margin; the hinge is toothless; the animal is oblong, elongated, thick, with the mantle prolonged and fringed posteriorly; the foot is very small, linguiform, and channelled; it carries a byssus at its base during the early period of the animal's existence, but this is afterwards lost. The Lithodomi are rock-borers. In the early stages of their life they live like mussels moored by their byssus to masses of stone, madrepores, &c., but soon, impelled by an instinct which cannot fail to excite surprise, they commence boring the rocks or masses of madrepore to which they were attached, and form galleries into which they work their way, boring and enlarging the cavity as they proceed, and in which they are imprisoned during life; for their volume increasing as they advance in age, they cannot retreat by the way through which they have effected their entrance. Their byssus is now useless, it becomes lost, and is never reproduced.

Lithodomi are common in the warmer seas of Europe, as the Mediterranean, and also in the seas of the Antilles.

With respect to the mode in which these animals effect their mining operations, in stones and hard madrepore, we have many theories, but nothing positive. That the delicate valves are capable of acting as raspers on such rough dense materials is scarcely to be believed. Is there any solvent used? if so, would not such solvent eat away the shell as well as the rock, and leave the animal to perish? Can it be by the action of incessant currents of water, produced by the vibratile action of the branchiæ, directed against the point to be worn down, and that perhaps with more impetus than might be supposed? Such, we reply, is Mr. Garner's opinion. But for these effects to be produced by such an operation, for the rock to be chambered by little currents of water, and that not in the course of a lapse of years, but with considerable dispatch, is indeed startling. We know that a perpetual current bubbling from its fountain will wear down the asperities of the rudest granite; but then time must pass, ages glide away. Here on the contrary the rock is bored, the mollusk self-buried, and onwards, mole-like, it drives its levels.

2914.—THE FINGER LITHODOMUS

(*Lithodomus dactylus*). *a*, the young with the byssus; *b*, the full-grown shell, showing the inside of one of the valves; *c*, the valve seen outside; *d*, three specimens in a mass of madrepore. This species is very common in the Mediterranean, and is in considerable esteem as an article of food, being plump, juicy, and highly flavoured. It is generally served up in the form of a stew, which is said to be excellent. Cuvier alludes to the agreeable flavour of its flesh, "à cause de son goût poivré."

We may now turn to the genus Pinna, on which we have previously ventured a few observations.

In most cabinets the great fan-like, delicate valves of these shells are to be observed, no one can overlook them; they resemble huge expanded flattened mussels, with an elongated acute apex, and a dusky roughened surface; and with them we generally observe large tufts of delicate brown byssus, and gloves or similar articles manufactured with this silk-like material.

M. Rang characterizes the shell in this genus as fibrous and horny; rather fragile, and delicate; regular, equivalve, triangular, pointed anteriorly, rounded posteriorly. The hinge is linear, striate, and toothless; the ligament is marginal, a great portion of it internal. Anterior muscular impression small and entirely in the umbonal angle; posterior muscular impression very large. The mollusk has the lobes of the mantle disunited along their ventral border; there are no projecting siphons, and the foot is conical or tongue-like, and slender. An elaborate anatomy of this animal, which he calls Chimæra, has been given in his great work by Poli.

In the old shells of Pinna we observe a tendency of the valves towards a laminated structure; but in the young, the lamination is not only more distinct, but the different layers rise up externally, forming rows of fringes or subtubular spines. These wear down as the animal increases, and at last almost entirely disappear. If, however, a young spinose pinna be placed by the side of an adult shell, few would regard them as specifically the same, unless previously aware of the fact; and indeed, species have been fabricated on this very ground.

The Pinnæ, or Les Jambonneaux of the French, attain to a large size. The great Mediterranean Pinna (Pinna flabellum), sometimes exceeds two feet in length. These shells are generally found in deep water, on sandy bottoms, but at no great distance from the shore, on sandy bottoms, moored by the byssus; it is said that the animal is sometimes fixed by its byssus, and sometimes removes itself by the aid of its foot.

This byssus, instead of consisting of coarse scanty fibres, is fine, silken, glossy, and abundant. It is employed in Italy for the manufacture of various articles, which find a ready market; it does not, we

believe, take any dye. Cuvier says, "Le Byssus s'emploie pour fabriquer des étoffes précieuses;" but this cannot, we imagine, be to any extent. All we have seen of this fabric are merely gloves, stockings, and the like. Small pearls are often found on opening the shells.

Fig. 2915 represents, *a*, the young of the Pinna flabellum beset with recurved spines; *b*, the inside of one of the valves of a full-grown shell, one-fifth natural size.

Fig. 2916 represents a specimen of the Pinna full-grown, with the byssus; one-fifth natural size.

With respect to the fossil Mytilidæ, they are not very numerous; some however occur in beds below the chalk, as well as in those above, but especially in the crag. Of Mytilus, from ten to fifteen appear to be determined. Of Dreissina, a species occurs in the modern Calcaire in some parts of Germany, and to this genus may be referred the Mytilus Brardi, Fig. 2917:—*a*, hinge and septum enlarged; *b*, outside of valve; *c*, the inside of ditto.

Of Modiola, M. Deshayes, in his last edition of Lamarck, enumerates twenty; but to this number a few other species have to be added. Of Lithodomus five or six species appear to be known. With respect to Pinna, several fossil species occur in the secondary and tertiary beds of marine origin.

Family NAIDÆ (Fresh-water Mussels, Unio, Anodon, &c.; Les Anodontes and les Mulètes of Cuvier).

This interesting family is extensively spread; the rivers, fresh-water lakes, and pools of Europe produce many species, but it is in the rivers of North America that the group is most numerous. Dr. Leach, Mr. Swainson, Dr. Kirtland (in 'American Journal of Science and Arts,' vol. xxvi.), and Mr. Lea have greatly contributed to the elucidation of this family.

The genera are all closely related to each other, the distinguishing characteristics being all of a minor importance, insomuch that several genera established by various naturalists have insufficient foundations. Such at least is the opinion of Mr. Swainson.

Till very recently the Naïdæ were regarded as bisexual, like the oyster, edible mussel, &c., and such was formerly Mr. Lea's opinion, as it had been that of Lamarck, who observed the viviparous nature of these mollusks, stating that the eggs pass into the duct placed along the superior branchiæ, where the young are found with their shells complete. In confirmation of this viviparous mode of reproduction, Mr. Lea, as he states, on the dissection of a specimen of Anodonta undulata (Anodon undulatus), nearly three inches long, found the egg-ducts charged with about six hundred thousand young shells perfectly formed, both valves being distinctly visible with the microscope.

While pursuing his observations on these fluviatile mollusks, Dr. Kirtland, of Poland, Ohio, informed Mr. Lea of the fact that these mollusks were individually males, and individually females; and that he was able to distinguish between the males and females by the form of the shell, without having recourse to the included animal. Shortly afterwards, Dr. Kirtland's paper on the subject appeared in the 'American Journal of Science and Arts.'

Mr. Lea then instituted a series of observations which fully satisfied him as to the truth of the individual difference of sexes. The female sustaining her very large burden, naturally requires more space within the valves: hence, as compared with that of the male, the shell at its posterior part is generally enlarged, differing however in form in the various species. This difference of form, easily seized on by a practised eye, is the distinguishing criterion by which the females are to be recognized.

The observations of Mr. Lea are accompanied by explanatory illustrations, of which we here avail ourselves.

Fig. 2918 and 2919 represent the Unio irroratus. At Fig. 2918 the shell is seen in an internal and external aspect; at Fig. 2919, A represents the soft parts, showing the interior of the oviduct; B, the exterior of the same. *a*, the mouth; *b*, the great adductor muscle; *c*, the right superior branchia; *d*, the great posterior muscle; *e*, the inferior right branchia; *f*, the right oviduct; *g*, the foot; *h*, the superior left branchia; *i*, interior view of oviduct.

At Fig. 2920, Unio ochraceus, and at Fig. 2921, Unio cariosus, the appearances exhibited by the female mollusk are displayed, one of the valves being removed and the oviducts exposed. These sacculated repositories would almost induce us to term the animals marsupial mollusks. In these the eggs, subjected to the action of the water, become developed, the young, previously to exclusion, being covered by their shells, and except in size, differing little from their parent.

Fig. 2922 represents the female of Anodonta fluviatilis (Anodon fluviatilis). In his paper on the Lamellibranchiate Conchifera, Mr. Garner gives a figure of the young animal from the eggsac of an Anodon, as seen in the field of a microscope, one-third of an inch focus.

Fig. 2923 represents the mollusk of Anodonta undulata (Anodon undulatus).

Mr. Lea remarks that the mass of lobes in this species differs from the mass of lobes in A. fluviatilis, the tint being darker, and the arrangement of the oviducts very remarkable. The ova or eggs are placed in a kind of sac, lying across the lobe, and presenting one end to the stomach, the other to the mantle of the animal. They lie so closely together as to assume on the exterior a form like that presented by the cells of a honeycomb. This, says Mr. Lea, is of course produced by pressure. Some of these sacculi when carefully opened were found to contain as many as twelve ova; each with a perfect living shell in it, having a brown epidermis. Referring to Fig. 2923, *a* represents a sacculus with its ova; *b*, the egg or ovum with its perfect young shell included; *c*, the honeycomb appearance, the portion being eight times magnified.

Figs. 2924 and 2925 represent two females of Unio radiatus, as they lay at rest on the bottom of a basin of water: Mr. Lea observes that these females exhibited two very different forms as regards the inferior portion of the mantle. These differences will be seen by reference to the figures.

With respect to the food of the Naïdæ it appears to consist of minute animal and vegetable matters, —Mr. Lea says that he has strong reasons for believing that the former constitute their principal support. Animalcules indeed abound in all current or stagnant water, and these he thinks the mollusks separate, from the constant stream which leaves the branchiæ and passes out by one of the siphons. The operation he witnessed frequently in a vessel in which he kept the Naïdæ for some months. If the water was not changed for twenty-four hours, he uniformly found the animals quiet, but within a few minutes after it was changed, they as uniformly commenced the passage of this constant stream. He adds that he cannot suppose this operation to be for the sole purpose of breathing, as there is no intermission in the stream of water, and the quantity thrown out is too great for this purpose only. He therefore believes it to be the result of the action of the separation of the animalcules from the water. Of this however there is no definite proof, and we must remember the stimulus which the internal organs and branchiæ would receive from the fresh water, and though this rapid transmission of fluid may subserve the purpose of acquiring food, yet we suspect that the action in question resulted from the change of spoiled and exhausted water, for that replete with oxygen.

The shells of the Naïdæ are many of them lined with a most brilliant nacre, and are besides of considerable thickness. When we consider the origin of pearls and their identity with nacre, it will not surprise us to learn that these valued ornaments are abundantly produced by many species. One species indeed, abundant in our rivers, namely the Mya margaritifera of Linnæus (Unio elongatus), has been long celebrated for this production, and according to Pennant there were formerly regular pearl-fisheries established on many of our rivers. As early indeed as the time of the invasion of our island by Julius Cæsar, British pearls were celebrated; and, according to Suetonius, one inducement at least to the descent of the great Roman and his legions on our island was the acquisition of these valuables—not that we credit such a story; statesmen and warriors are influenced by far different motives in their plans of usurpation and conquest. It would however appear that Cæsar dedicated a breast-plate adorned with British pearls to Venus, in her temple; but Pliny, who speaks of the pearls of our island, refers to these very specimens (which were small and ill-coloured) as a proof of their inferiority.

In far later days, however, several rivers were noted,—among these were the Esk and the Conway. In the days of Camden (who died in 1623), the latter river had not lost its reputation; and Sir Richard Wynn of Gwydir, chamberlain to Catherine, queen to Charles II., is said to have presented her majesty with a Conway pearl, which, says Pennant, is to this day honoured with a place in the regal crown. The river Irt in Cumberland was also famous for pearls, and the circumnavigator Sir John Hawkins had a patent for the pearl-fishery of that river.

Nor is it to the rivers of England alone that pearl-bearing mussels are limited. Ireland is not without her share, and some specimens of considerable size and value have been procured, especially in the rivers of Tyrone and Donegal; we are informed of one which weighed thirty-six carats (a carat is nearly four grains), and was estimated at forty pounds, but was not of perfect shape and colour, otherwise it would have been more valuable. Other pearls have been sold from four to ten pounds, and one purchased at the latter sum was deemed so admirable, that, as Pennant states, Lady Glenlealy refused eighty pounds for it from the Duchess of Ormond.

We have seen pearls from the Unio of our rivers, but none of any size or great clearness.

With respect to locomotion,—as they want the byssus, these mollusks are never attached, and the large foot serves them as a sort of propeller in traversing the muddy floor of the pond or river: in order to execute these movements, they partially open the valves, protrude the foot, and gradually set themselves up on their edge; they then proceed by a series of impulsive movements, leaving a furrow in the mud behind them.

The genus Unio is distinguished by cardinal teeth; the right valve has anteriorly a short fosset, for the reception of a tooth of the left valve, and behind this a thin lamina or ridge, received into a furrow between two laminæ of the left valve. In the genus Anodon there are no cardinal teeth.

Mr. Lea arranges the Naïdæ in two groups, which he terms Margarita (a title preoccupied) and Platiris.

Group MARGARITA.

Subgenus Unio.—Having a cardinal and lateral tooth.

Symphynote.—Example, Unio alatus.

2926.—The Winged Unio

(*Unio alatus*). *a*, part of the wing of the valve broken off, showing the symphynote character reduced.

Non-symphynote.—Example, Unio pictorum.

2927.—The Painters' Mussel

(*Unio pictorum*). This well known species, of which our figures represent the young shells, is very common in our rivers. Several specimens from the Thames are now before us. The valves are of tolerable thickness.

Subgenus Margaritana.—Having one tooth, cardinal.

Non-symphynote.—Example, Alasmodonta undulata, Say.

2928.—The Undulated Unio

(*Alasmodonta undulata*, Say). This species is a native of North America.

Symphynote.—Example, Alasmodonta complanata.

2929.—The Flattened Unio

(*Alasmodonta complanata*). This species is remarkable for its flattened form, and wing-like appendage, resembling that of Unio alatus.

Subgenus Dipsas.—Having a linear tooth on the dorsal margin.

Symphynote.—Example, Dipsas plicatus, Leach.

2930.—The Folded Unio

(*Dipsas plicatus*). The term Dipsas is inadmissible, time immemorial it has been appropriated to a species of serpent.

Subgenus Anodonta (Anodon).—Having no teeth.

Symphynote.—Example, Symphynota magnifica, Lea.

2931.—The Splendid Anodon

(*Symphynota magnifica*, Lea). Anodon magnificus.

This beautiful species was first described by Mr. Lea; it is a native of North America.

Non-symphynote.—Example, Anodon fluviatilis.

2932.—The Fluviatile Anodon

(*Anodon fluviatilis*). This species is common in our fresh waters.

Group PLATIRIS, Lea. Non-symphynote.

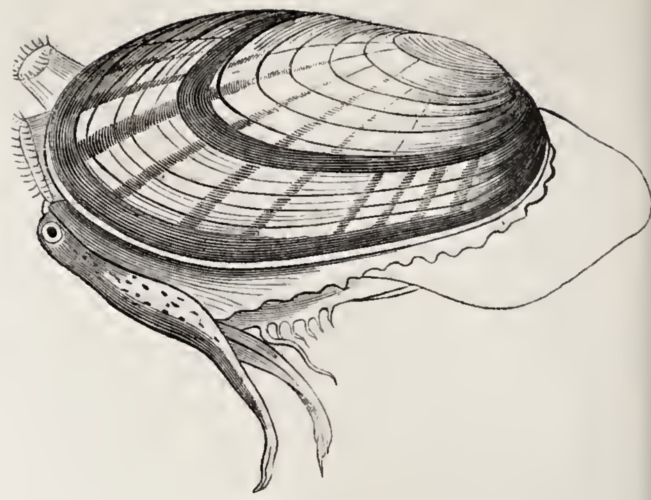
Subgenus Iridina.—Having a crenulate dorsal margin. Example, Iridina exotica.

2933.—The Exotic Iridina

(*Iridina exotica*). Lamarck gives the rivers of warm climates as the locality of this genus. The present species (Iridina elongata, Sowerby) is supposed to come from China. Mr Caillaud found it (if the species be identical) in the Nile, in considerable abundance, but we suspect that M. Caillaud's specimens are referable to a species described and figured in the 'Zool. Journal,' vol. i., by Mr. G. B. Sowerby, under the name of Iridina nilotica, obtained in Sennaar by M. Caillaud, and sent to England by M. D'Audebard. Its hinge margin is not crenulated or dentated. Mr. Lea makes it the type of a distinct subgenus.

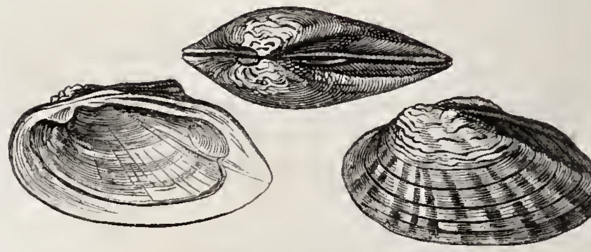
Subgenus Spatha.—Dorsal margin non-crenulate.


2924.—Unio radiatus.

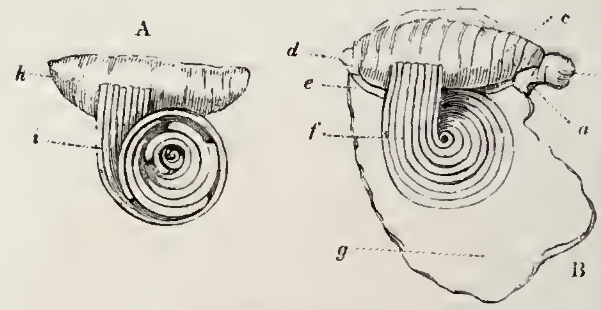

2925.—Unio radiatus.


2928.—Undulated Unio.

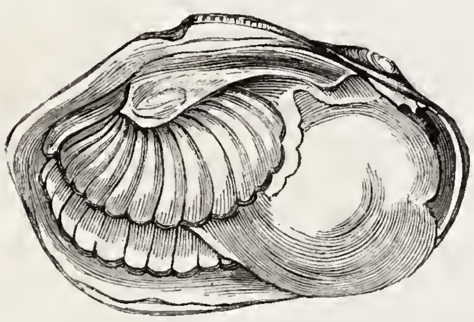

2921.—Unio cariosus.

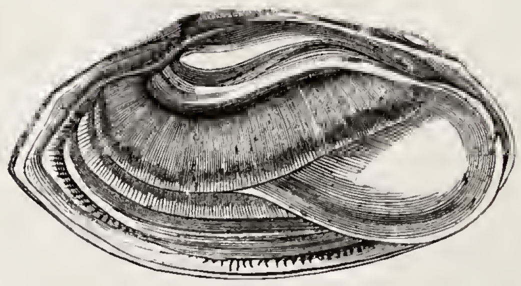

2927.—Painters' Mussel.

2917.—Mytilus Brardi.



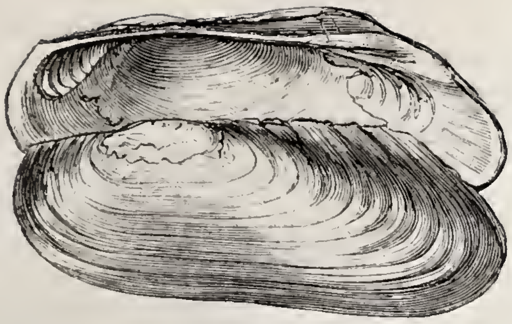
2919.—Unio irroratus.


2920.—Unio ochraceus.

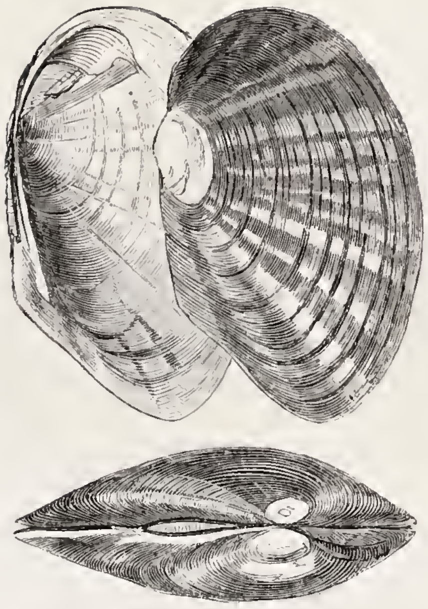

2922.—Anodon fluviatilis.


2918.—Unio irroratus.

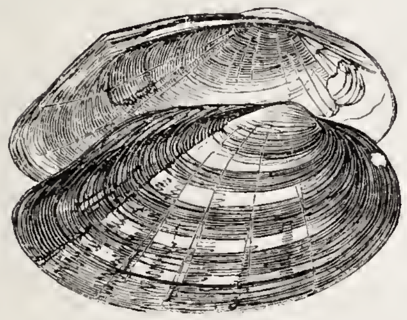
2923.—Anodon undulatum.

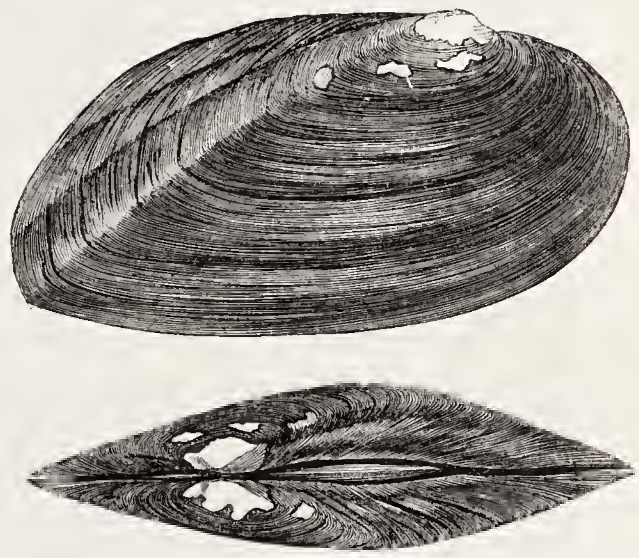

2934.—Nile Iridina.

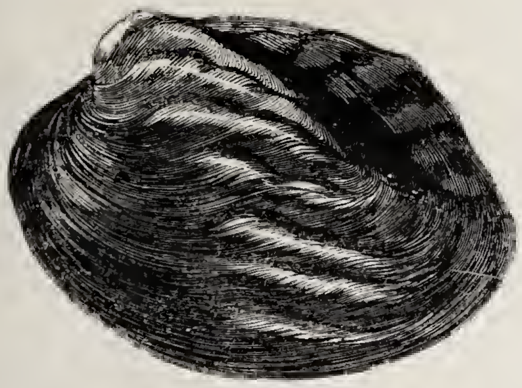

2929.—Flattened Unio.

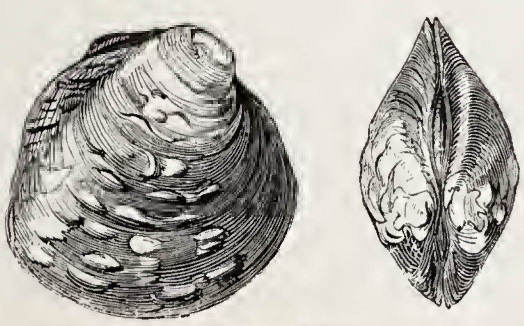

2931.—Splendid Anodon.

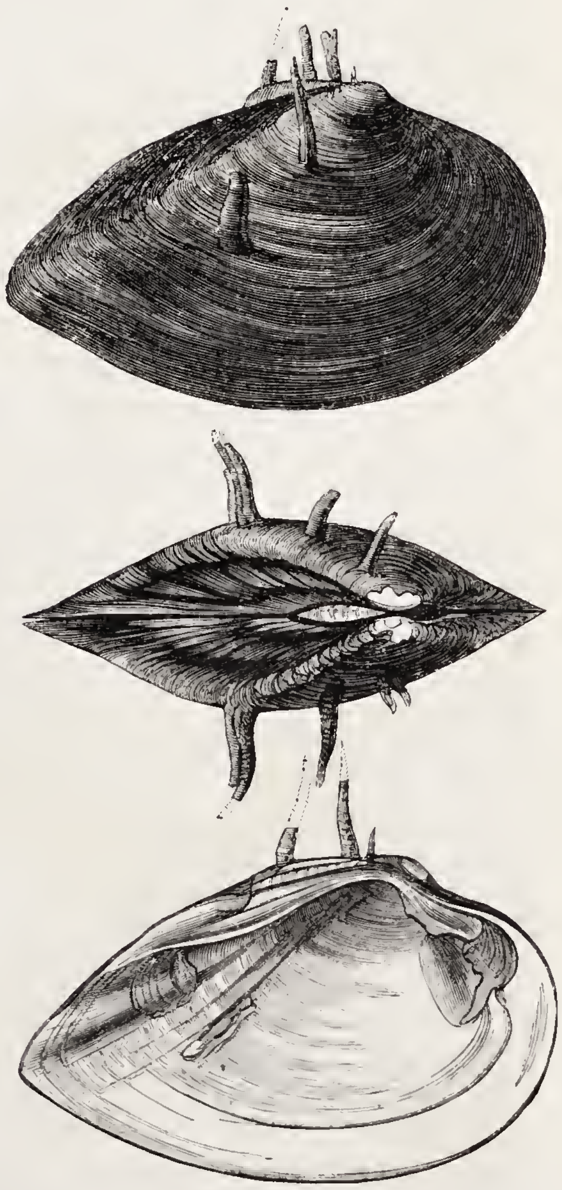
2926.—Winged Unio.

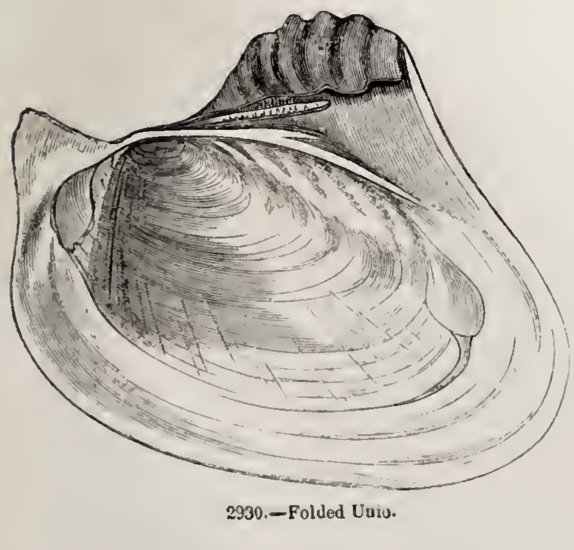

2932.—Fluviatile Anodon.

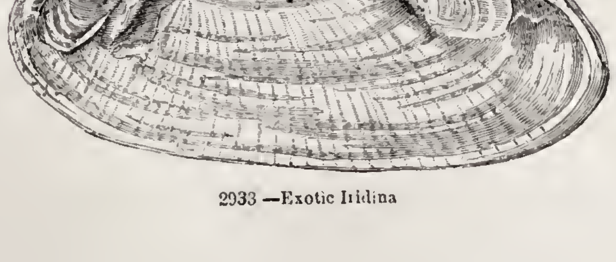

2937.—Purple Unio.


2935.—Plicate Unio.


2936.—Pustular Unio.


2938.—Spinous Unio.


2930.—Folded Unio.


2933.—Exotic Iridina

2934.—The Nile Iridina

(*Iridina nilotica*, Sowerb.) Spatha nilotica, Lea. We have already alluded to this species, which M. Deshayes, in his last edition of Lamarck, makes identical with Iridina exotica (Anodonta exotica, Blainv., and Le Mutel, Adanson), but from which it is distinct. According to Rang the genus Iridina belongs to the cockle family, Cardiacea, Cuvier, Conchacea, De Blainville.

To these forms are added others divided into—Plicate shells, Nodulous shells, Smooth shells, and Spinous shells.

Plicate Shells.

2935.—The Plicate Unio

(*Unio plicatus*). This species is remarkable for the waved elevations of the valves; it is a handsome species.

Nodulous Shells.

2936.—The Pustular Unio

(*Unio pustulosus*). The somewhat rounded valves of this shell are covered with pustular elevations; it was first described by Mr. Lea.

Smooth Shells.

2937.—The Purple Unio

(*Unio purpureus*). Unio complanatus. This richly coloured Unio is a native of America. It was first described by Say.

Spinous Shells.

2938.—The Spinous Unio

(*Unio spinosus*). This species, first characterized by Mr. Lea, appears to have been discovered by Bartram, who found it in the Mississippi. It is remarkable for the spines that rise abruptly from the valves.

With respect to the arrangement proposed by Mr. Lea, it appears to be completely artificial; and we agree with Mr. Swainson, who says that no permanent characters will be found to retain either the genera Dipsas (Leach), Hyria (Lamarck), or Alasmodonta (Say). Yet in the second series of his 'Zoological Observations' the same writer retains as genera Unio, Hyria, Iridina, Anodon, and Alasmodon.

In the Naïdæ the foot is very large, and compressed, almost quadrangular, and of considerable mobility; the mantle is garnished posteriorly with little tentacles or filaments, and its borders are free.

It would appear that about three hundred and twenty-three recent species are known. Mr. Lea in his tables thus enumerates them:—

Of the subgenus Unio.—Two hundred and thirty-five species, and twenty which he has not been able to admit as certain. Distribution—Europe, Asia, Africa, North America, and New Holland, but by far most abundant in North America.

Subgenus Margaritana.—Twenty admitted, two unknown. Distribution—Europe, North America, South America, and perhaps Africa.

Subgenus Dipsas.—Two recent, Asia.

Subgenus Anodon.—Fifty-eight admitted; seven unknown to Mr. Lea. Distribution — Europe, Africa, North America, South America, New Holland.

Subgenus Iridina.—Two recent, Africa.

Subgenus Spatha.—Six recent; Africa and South America.

Numerous as are the recent species of Naïdæ, there appears to be a great paucity of fossil forms. Mr. Sowerby, indeed, referring to Anodon in his 'Genera,' says, that unless we are justified in considering the Bivalve from the Coal Measures, figured in the British mineralogy under the name of Mytilus crassus, as an Anodon, he knows of no fossil species. Subsequently in the same work he refers many fossil shells found particularly in the Coal Measures to the genus Unio; judging alone from the casts of the inside, and comparing them with recent species.

Dr. Mantell, Professor Phillips, Mr. Lonsdale, and Dr. Fitton record various species of Unio, from the Plastic clay, the Ashburnham beds, the cornbrash, the inferior oolite, &c.; and Mr. Lea gives twenty-one as the number of fossil species of Unio and one (doubtful) of Anodon. With respect to the Unio Listeri, U. hybridus, and U. concinnus, figured in 'Mineral Conchology,' Mr. Sowerby remarks that these occurring in the oolite, together with U. crassiusculus, all want the distinguishing marks of the genus; and that judging by their hinges alone he should hesitate to regard them as belonging to the genus Unio.

M. de Blainville, who divides the Naïdæ (or his Submytilacea) into two sections, viz. those which have an epidermis, are nacreous, and the inhabitants of fresh waters; and those which have no evident epidermis, are not nacreous, and are more or less pectinated, places in the latter section the genus Cardita and subgenus Venericardia. This genus is also approximated by Cuvier to the Unios; and M. Deshayes, commenting upon the position assigned it by Lamarck, between Cardium and Cypricardia (Fam. Cardiidæ), observes that such is not its true position, and we must here follow the example of Cuvier and De Blainville. The animal resembles that of Unio. The shell is very thick, solid, equivalve, often very inequilateral, with the umbones curved forwards; the hinge presents two oblique unequal teeth, one short and cardinal; the other long, lamellar, bent, and placed much more backwards. The ligament is elongated, subexternal, and sunk into the shell. The muscular impressions are rather large and distinct; the pallial impression narrow.

These mollusks are marine, and are generally found on muddy or sandy bottoms, varying in depth to forty or fifty fathoms.

2939.—The Calyculate Cardita

(*Cardita calyculata*). Nearly without exception the Carditæ have longitudinal ribs, the shell is solid and heavy, and the lunule much sunk. In the present species the shell is oblong, white, varied with lunate spots of brown; the ribs are squamous, the scales being arched, and incumbent; *a* shows the shell with the umbones and lunule turned towards the spectator.

2940.—The Imbricate Cardita

(*Cardita imbricata*). Venericardia imbricata. This species of the genus or rather subgenus Venericardia occurs only in a fossil state; the left-hand specimen is from Grignon, that on the right is a variety from Courtagnon.

In uniting the species of Cardia and Venericardia, says M. Deshayes, and placing them in their most natural positions, the passage between them, as we pursue the series, will be found to be so insensible that it will be impossible to say where one commences and the other terminates, and when the internal characters are examined the same resemblance is observable as in the external forms.

With respect to the number of species, M. Deshayes in his Tables makes out a list of twenty-five, joining the two genera together; and of these six are found both in a living and a fossil state. In the last edition of Lamarck he gives the number of living Carditæ as twenty-one, and observes that of Venericardia the only living species noticed is the V. australis, from the seas of New Holland.

In the 'Proceeds. Zool. Soc.' for 1832, three new species of Cardita are described by Mr. Broderip (pp. 55, 56), and six species by Mr. G. B. Sowerby (pp. 194, 195), all brought by Mr. Cuming from the coasts of central America, the Gallapagos, and some islands in the South Pacific (Crescent and Rapa Islands).

One of these species, Cardita Cuvieri, far exceeds, says Mr. Broderip, "in size and beauty any Cardita hitherto discovered; it was dredged from sandy mud in eleven fathoms of water, about seven miles from the shore (in Fonseca Bay). After its capture the dredge was kept at work for some hours, but no other specimen could be procured. The ribs are broad, flattened on their superior surface, but very elevated and strongly geniculated; the geniculations being for the most part three-tenths of an inch from each other. The shell is a very striking object, and has the appearance of a carved work."

The number of fossil species of Venericardia and Cardita are enumerated by M. Deshayes in his Tables at fifty. In his last edition of Lamarck, the number of fossil Venericardiæ is given as ten, and of Carditæ (fossil only) seven.

Mr. Lea describes and figures four new species from the tertiary of Alabama. ('Contributions to Geology.') Dr. Mantell, Professor Phillips, Mr. Lonsdale, Professor Sedgwick, Mr. Murchison, and Dr. Fitton enumerate various species of fossil Cardita and Venericardia from the blue clay, the arenaceous limestone of Bagnor; the upper green sand, the Bath oolite, the inferior oolite, the Gosau deposit, and its equivalents in the Alps, the gault, &c.

We may here appropriately turn to another family, the Polydonta of M. de Blainville, the Arcada of Lamarck, placed by most writers near the Naïdæ, and by M. de Blainville between these and the Mytilidæ. Lamarck places them between the Naïdæ and Cardiidæ.

Family ARCADÆ (Ark-shells, Arca, Cucullæa, Pectunculus, &c.).

M. Rang characterizes the Arcadæ as follows:—The mollusk has the mantle entirely open throughout its circumference, excepting towards the back, without siphons or any particular apertures; and partially adherent, sometimes prolonged backwards. The foot is always very considerable.

The shell is generally thick, regular, equivalve, inequilateral, with a similar hinge in each valve, always formed of a series of teeth, which are often lamellar, fitting into each other, straight or oblique. The muscular impressions are nearly always united together by an intervening pallial mark, which is narrow and runs parallel to the border of the shell.

The first genus, Cucullæa, is very limited in species; only one, we believe, being as yet known. The shell is thick, the umbones boldly elevated and distant; the hinge is linear and straight; ligament external; teeth transverse and small, others oblique and longitudinal; anterior muscular impression forming a projection with an angular border. The general shape and appearance of the shell, which is of moderate size, will be easily appreciated by reference to the specimen.

2941.—The Eared Cucullæa

(*Cucullæa auriculifera*). This handsome shell is a native of the Indian Ocean, and occurs on beds of sand. Externally the valves present both longitudinal and transverse striæ. The general colour of the outer surface is deep cinnamon brown; the internal surface assumes a brown tinge towards the anterior part, passing into violet.

We now pass to the genus Arca. The shell is boat-shaped, rather thick, equivalve, but inequilateral; the form is elongated, more or less oblique; the umbones are distant, often a little curved forwards, hinge linear and straight, with numerous small interlocking teeth; ligament external. M. Rang remarks that the species sometimes adhere by their foot, and more frequently by means of a byssus.

2942, 2943.—Noah's Ark

(*Arca Noæ*). Byssaarca Noæ, Swainson. This species, constituting the type of the subgenus Byssaarca, is a native of the Atlantic Ocean, and of the seas of Europe. Mr. Swainson, who established the subgenus, says, "The animals of these shells affix themselves to other bodies, by a particular muscle; which is protruded through the gaping part of the valves. They also adhere when young by means of the byssiform epidermis, which covers the exterior. A specimen now before us, which we procured in the Bay of Naples, perfectly exemplifies this singular property."

In the 'Proceeds. Zool. Soc.' 1833, p. 17 et seq., will be found the description of fourteen new species, by Mr. G. B. Sowerby. They were procured by Mr. Cuming on the western coast of South America, and among the islands of the South Pacific Ocean; and were found moored to stones, shells, and coral rock, at depths varying from the surface at low water, to the depth of many fathoms.

Referring to Fig. 2942, *a* shows the shell with the valves closed, and the hinge towards the spectator; *b*, the valves closed, with the edge or inferior aspect to the spectator, showing the hiatus; *c*, internal view of one of the valves.

At Fig 2943, A is a lateral view of the shell with the valves closed; B, the shell with the hinge and umbones presented; C, a single valve showing the hinge. *a*, the umbones; *b*, the margin where the valves gape to give room for the extrusion of the tendinous foot.

2944.—The Tortuous Ark

(*Arca tortuosa*). Trisis tortuosa, Oken. In this subgenus Trisis, the shell is twisted; the valves are obliquely carinated; the umbones small and recurved.

This species is a native of the Indian Ocean.

Referring to Fig. 2944, *a* represents the internal view of one of the valves, showing the character of the hinge; *b*, the shell with the valves close, presenting the inferior margin; *c*, the external view of one of the valves.

2945.—The Antique Arca

(*Arca antiquata*). The shell of this species is transverse, obliquely cordate, ventricose, and many-ribbed; the ribs are transversely striated; the posterior ribs bifid. Colour white. The Arca antiquata is found in the Indian Ocean, on the coast of Africa, and according to Lamarck in the Mediterranean. According to M. Deshayes it has been confounded since the time of Linnæus with another species, both being included under the same specific title; yet he says that they are easily distinguished. The true Arca antiquata, figured in 'Gualt. Test.' pl. 87, f. C.; in 'Chemn. Conch.' t. vii., pl. 55, f. 548, has the shell thicker, the ribs flatter and wider than in the other species; they are also striated, and there are no furrows on the cardinal surface. The other species is less solid, and more transverse, and has the cardinal surface always furrowed when the valves are united. He further remarks that the shell figured by Poli and cited by Lamarck is a species again distinct from these two. It inhabits the Mediterranean, and is the living representative of a

fossil species, viz., Arca diluvii; and this latter is figured by Brocchi as Arca antiquata. Such was the confusion in which the Arca antiquata remained, until cleared up by the celebrated naturalist above alluded to.

We now pass to the genus Pectunculus, in which the shell is thick, solid, equivalve, nearly equilateral, entirely closed, with small umbones more or less distant, and an external ligament. The hinge presents a curvilinear row of small narrow teeth, rather numerous, and intrant; they are often incomplete under the umbones.

The animal is rounded and thick, with no tentacular filaments on the border of its mantle; the labial appendages are narrow, the foot is large, compressed, and slit longitudinally.

The Pectunculi live on sandy or muddy bottoms, and move by means of their large powerful foot with considerable dispatch, propelling themselves vigorously along. They are found in depths varying from a few feet to seventeen fathoms. They have no byssus.

2946.—The Hairy Pectunculus

(*Pectunculus pilosus*). The term hairy or pilosous is given to this species because the shell is covered with a brown hairy epidermis, giving it a singular appearance. The shell is orbiculate and ovate, with oblique umbones, and marked by decussate striæ. It is a native of the Atlantic, and occurs also in the Mediterranean.

Of this genus M. Deshayes enumerates twenty in his last edition of Lamarck; but to these must be added three species described by Mr. Broderip in the 'Proceeds. Zool. Soc.' 1832, p. 126, and six species described by Mr. G. B. Sowerby in the same Proceeds. p. 195 et seq.; all from the western coast of South America, and the islands of the South Pacific Ocean. Several fossil species are recorded.

The next genus to be noticed is Nucula of Lamarck, which is characterized by the shell being rather thick, sometimes nacreous; subtriquetrous in form, equivalve, but inequilateral; the umbones are contiguous and curved forwards; the hinge exhibits on each valve a row of numerous small pointed teeth disposed in a line, but interrupted at the umbo. The ligament is to a great extent internal, and is inserted into a small oblique fosset in each valve.

The animal is rather thick, with the mantle open only at its inferior portion; its borders are entire, denticulated throughout the length of the back, without posterior prolongations; the anterior oval appendages are long, pointed, and stiff; the posterior stiff and vertical. The foot is large, slender at its root, and expanding into a great oval disc, the borders of which are furnished with tentacular digitations.

Fig. 2947 represents the animal and shell of Nucula Australis. A, the animal; *a a*, the mantle, denticulated along the dorsal margin; *b*, the foot unexpanded; *e e*, the two adductor muscles; *c*, the branchiæ. B, outline of the shell, with the foot of the mollusk projecting.

The Nuculæ generally tenant beds of sandy mud, both in æstuaries and the open sea, varying from the surface to sixty fathoms. One species, Nucula Pisum, Sowerby, was found by Mr. Cuming on coarse sand and gravel at various depths from seven to forty fathoms, and N. cuneata from fourteen to forty-five fathoms; hence it would appear that the same species is capable of living under various degrees of pressure. The same conchologist found N. obliqua at the depth of fourteen fathoms, and at the depth of sixty fathoms.

2948.—The Beaked Nucula

(*Nucula rostrata*). In this species the shell is oblong, thin, transversely striated, and produced into a beak-like termination.

2949.—The Pearly Nucula

(*Nucula margaritacea*). The shell is obliquely ovate, trigonal, and rather smooth; the cardinal teeth are straight and acute, the margin is crenulated.

Referring to Fig. 2949, A represents the interior of the valve, showing the teeth on each side of the hinge, and the cartilaginous pit in the centre; B, the exterior of the valve; C, a view of the cardinal teeth, the margin of the shell being towards the observer, and enlarged; D, the shell with the valves closed, showing the umbones.

M. Deshayes records ten living species of Nucula in his last edition of Lamarck; in the 'Proceeds. Zool. Soc.' 1832, are ten new species from the western coast of South America, described by Mr. G. B. Sowerby; they formed part of Mr. Cuming's celebrated collection.

Immediately after the genus Nucula, Cuvier introduced the genus Trigonia of Bruguières, so remarkable for the hinge, which is furnished with two laminæ, en chevron, crenulated on each side, and received each into two fossets, or rather between four laminæ of the opposite valve, also crenulated internally. MM. Quoy and Gaimard, he adds, have recently discovered a living example of this genus. The animal, like that of arca, has the mantle open, without any separate orifice; the foot is large and compressed, and hook-shaped anteriorly. According to M. Deshayes, this genus is evidently near the Nuculæ, and the only question is whether it should form part of the family of the Arcadæ, or stand by itself as a small but independent family next to it.

M. Rang describes the shell as thick, nacreous, subtrigonal, equivalve, and inequilateral. The umbones are rather small, and but little curved; the hinge is complex and dissimilar; the right valve having two great teeth of an oblong form, diverging from the umbo, strongly furrowed, and penetrating into two excavations of the same form and equally furrowed on the left. The ligament is external.

One species only, in a living state, is known.

2950.—The Pearly Trigonia

(*Trigonia margaritacea*). This rare species has only been found in the seas of New Holland, on sandy mud, ranging in depth from six to fourteen fathoms. It is of moderate size. The shell is suborbiculate, nacreous within, and ribbed externally. The ribs are elevate, verrucose, somewhat sharp, and radiating. The margin is plicated. It is the Trigonia pectinata of Lamarck.

The fossil species of this genus are numerous; they occur in the green-sand, the lias, the upper and lower oolites, and throughout the oolitic series of Phillips and Conybeare. Dr. Fitton records twenty-two or more species, principally from the lower green-sand. The fossil Trigoniæ belong to a remote period. "We should," says Mr. Sowerby, "have been much disposed to doubt the probability of any species occurring in the strata above the green-sand, if Miss Salisbury had not shown us one which she dug out with her own hands at Muddiford. Notwithstanding this fact, the Trigonia may be said to characterize the beds below the chalk, and above the lias."

With respect to the fossil species of the other genera of the family Arcadæ, the following details, the result of no trifling labour and research, are given in the 'Penny Cyclopædia.'

"*Cucullæa.* Mr. G. B. Sowerby ('Genera') notices the fossil species as numerous; of these, he observes, one (Cuc. crassatina) is described by Lamarck, and is found in the neighbourhood of Beauvais and at Bordeaux, in beds similar to that of Grignon, but in England several species occur, both in the green-sand and in the inferior oolite, and are engraved in Sowerby's 'Mineral Conchology.' Mr. G. B. Sowerby adds, that those of the inferior oolite are also found at Bayeux in Normandy.

"The number of fossil species (tertiary) recorded by M. Deshayes in his Tables is two. In the last edition of Lamarck the number is six. Dr. Mantell, in his 'Tabular Arrangement of the Organic Remains of the County of Sussex,' notes a Cucullæa in the chalk marl, and adds that M. Brongniart sent him a similar cast from Rouen: also Cucullæa decussata, from the Shanklin sand (Feversham).

"Professor Phillips ('Organic Remains of the Yorkshire Coast') records Cucullææ oblonga, contracta, triangularis, and pectinata, from the coralline oolite; elongata from the coralline, Bath, and inferior oolite; concinna from the Oxford clay and Kelloway's rock; imperialis and cylindrica from the Bath oolite; cancellata from the Bath and inferior oolite; reticulata from the inferior oolite; and notices the occurrence of the form in the Speeton clay and the lias. In the second part (1836) he describes Cucullææ obtusa and arguta (Bolland). ('Illustrations of the Geology of Yorkshire.') Dr. Fitton, in his 'Stratigraphical and Local Distribution of Fossils,' in his valuable paper 'On the Strata below the Chalk' (1839), notices the following Cucullææ—carinata (Blackdown); costellata? (lower green-sand, Kent; Blackdown, Devon); decussata (upper green-sand, Isle of Wight; lower green-sand, Kent and Sussex; Blackdown); fibrosa (Blackdown, Devon); formosa (Blackdown); glabra (upper green-sand, Isle of Wight; lower green-sand, Kent; Blackdown, Devon); glabra? (lower green-sand, Sussex); doubtful (upper green-sand, Hampshire; lower green-sand, Kent); one or two other species (lower green-sand, Sussex); new (lower green-sand, Kent; Oxford oolite, Cambridge); a Cucullæa without any designation (lower green-sand, North Wilts); and a small species from the Portland sand, Dorsetshire.

"Mr. Lonsdale, in his elaborate paper 'On the Oolitic District of Bath,' mentions Cucullæa oblonga (inferior oolite, Wideombe Hill) and Cucullæa glabra (upper green-sand, neighbourhood of Warminster). Mr. Murchison ('Silurian System') describes and figures Cucullæa antiqua from the old red-sandstone (middle and lower beds only) and the upper Ludlow rock; Cuc. Cawdori from the upper Ludlow rock, with a ?; and Cuc. ovata from the old red-sandstone (middle and lower beds only). Professor Sedgwick and himself had previously given Gosau as a locality for Cucullæa carinata. ('Structure of the Eastern Alps.')

"*Arca.* The number of fossil species (tertiary) given by M. Deshayes in his Tables is fifty-four, several of which, as we have seen above, he records as both living and fossil (tertiary). In the last edition of Lamarck no more than eighteen, fossil only, are catalogued. Dr. Mantell mentions two or three undetermined species from the chalk marl (Ringmer), and Arca carinata from the firestone or upper green-sand (Southbourn, Sussex, and Devizes); and another (a very imperfect cast) from the gault or Folkstone marl (Ringmer). Professor Phillips notes Arcæ quadrisulcata and æmula from the coralline oolite, Yorkshire; Mr. Lonsdale notes an Arca from the inferior oolite (canal banks opposite Limpley Stoke), and another from Frome; also one from the Bradford clay. Professor Sedgwick and Mr. Murchison record one from Gosau. Dr. Fitton gives Arca carinata from the upper green-sand, Hampshire; A. rotundata from Blackdown, and an uncertain species from the lower green-sand, North Wilts, the Portland stone, Oxford, and the Oxford oolite, Cambridge. Mr. Murchison ('Silurian System') describes and figures Arca Eastnori from the Wenlock shale.

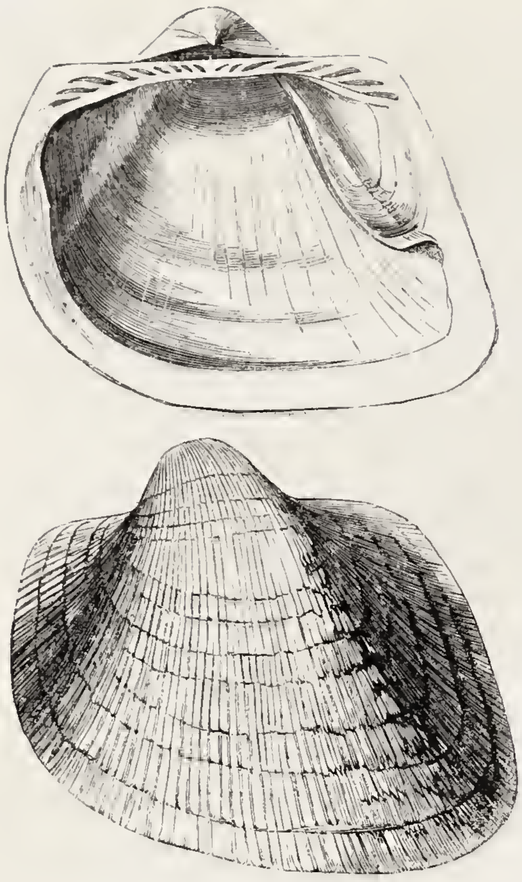
"*Pectunculus.* Mr. G. B. Sowerby ('Genera') states that all the species known to him are found either in the London clay or the calcaire grossier; he says that a very neat one occurs in the indurated marl at Bognor, where it is accompanied by fossil Pinnæ, Linguli, &c., and he has figured it, believing it to be a variety of Lamarck's Pectunculus pulvinatus, 'but in truth,' he adds, 'it is so difficult to fix the characters of the species of this genus, that we dare not speak decidedly upon this point.' M. Deshayes enumerates, in his Tables, twenty-seven fossil species (tertiary), and of these he notices three, as above mentioned, as both living and fossil (tertiary). In the last edition of Lamarck but fifteen species, fossil only, are catalogued. Dr. Mantell notes Pectunculus pulvinatus from the blue clay of Bracklesham; P. brevirostris and P. decussatus from the arenaceous limestone or sandstone of Bognor. Professor Sedgwick and Mr. Murchison enumerate Pectunculi Plumsteadiensis, brevirostris, pulvinatus? and calvus from the Gosau deposits; and Mr. Lea describes and figures Pectunculi Broderipii, minor, deltoideus, ellipsis, and obliqua from the Claiborne beds (tertiary), Alabama.

"*Nucula.* The number of fossil species (tertiary) published in the Tables of M. Deshayes is twenty-three, and four are enumerated as both living and fossil (tertiary). (See above.) In the last edition of Lamarck only seven are catalogued as fossil only. Dr. Mantell notices Nucula pectinata from the gault or Folkstone marl; and Nuc. impressa from Blackdown. Professor Phillips records Nuculæ ovata and subrecurva from the Speeton clay; subrecurva from the inferior oolite; another from the coralline oolite; elliptica and nuda from the Oxford clay; variabilis and lachryma from the Bath and inferior oolite; axiniformis, inferior oolite; ovum and complanata, upper lias; cuneata, tumida, undulata, claviformis?, and Luciniformis (Bolland, &c.), and brevirostris, Harelaw, Northumberland. (Yorkshire.) Mr. Lonsdale notes Nucula pectinata from the Bradford clay; and another from the forest marble. Professor Sedgwick and Mr. Murchison give us Nuculæ amygdaloides and concinna in their list of Gosau fossils. Dr. Fitton enumerates Nuculæ angulata (Blackdown); antiquata (lower green-sand, Sussex, and Blackdown); apiculata (Blackdown); bivirgata (gault, Kent); impressa (lower green-sand, Sussex, and Blackdown); lineata (Blackdown); obtusa (Blackdown); ovata (gault and lower green-sand, Kent); pectinata (gault, Kent, Cambridge, South Wilts, Blackdown, Devon); undulata? (gault, Kent), and another (gault, Bedford).

"Mr. Murchison figures and describes Nuculæ? ovalis, and lævis; the first from the upper Ludlow rock, the second from the Llandeilo flags. ('Sil. Syst.') Mr. Lea describes and figures Nuculæ Sedgwickii, ovula, pectuncularis, Brongniarti, media, pulcherrima, plicata, magna, carinifera, plana, and semen, from the Claiborne beds."

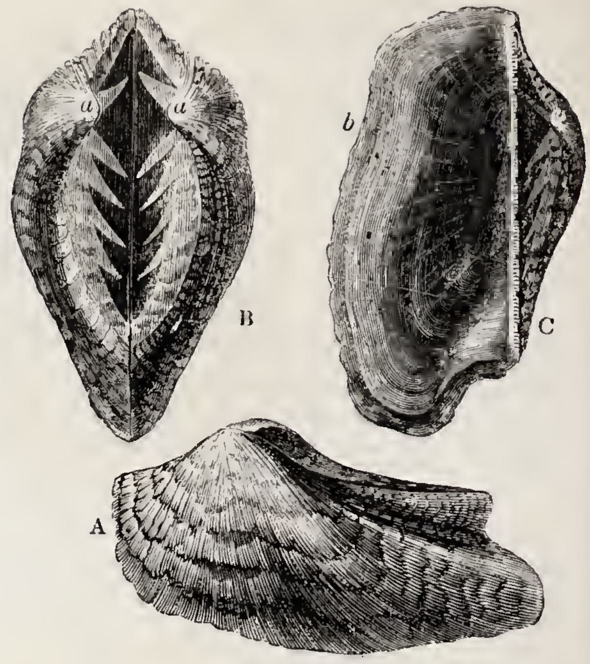
Family CHAMIDÆ (CLAMS, &c.).

Some naturalists of great eminence divide this family into two, viz. Tridacnidæ, of which the great clam Tridacna Gigas is the type, and Chamidæ, represented by Chama and Diceras. Certainly these form two distinct sections, if with Cuvier we include them under one family head. For the Tridacna is furnished with a strong byssus as a mode of attachment, and moreover has only one adductor muscle, of great power, fixed in the middle of the valves. It is an exception to the general rule, being Monomyarian.

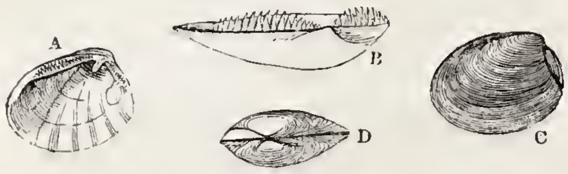


2941.—Eared Cucullæa.

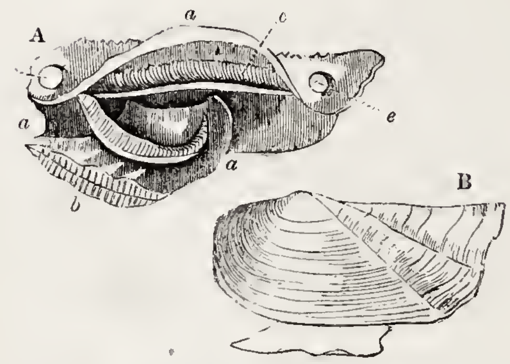
2946.—Hairy Pectunculus.



2943.—Noah's Ark.



2949.—Pearly Nucula.

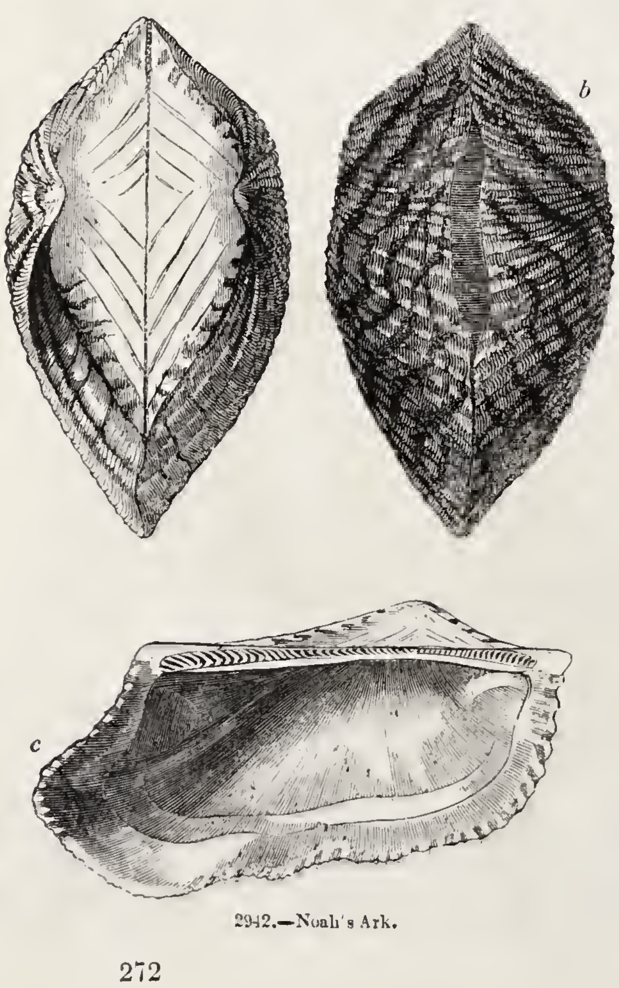


2947.—Nucula Australis.

2945.—Antique Arca.

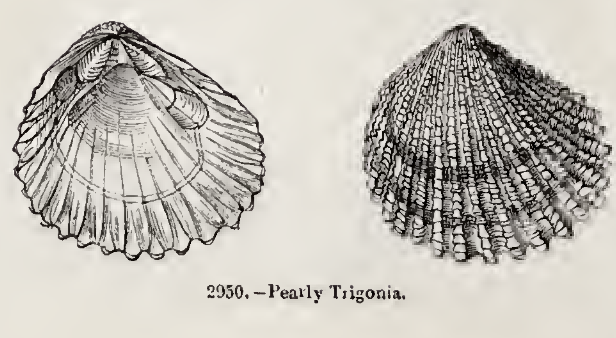
2940.—Imbricate Cardita.

2948.—Beaked Nucula.

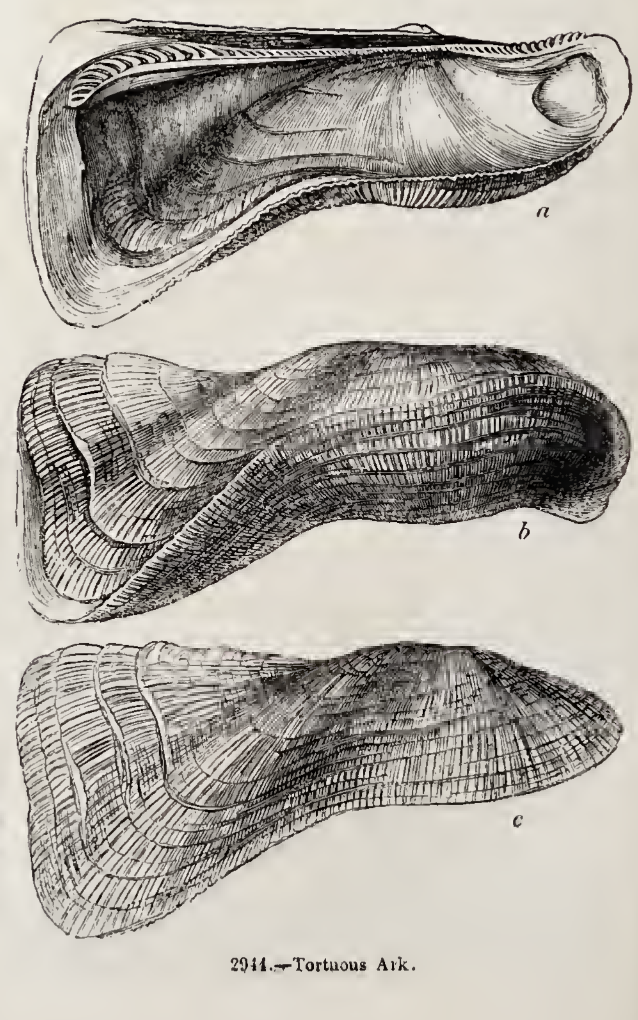


2942.—Noah's Ark.

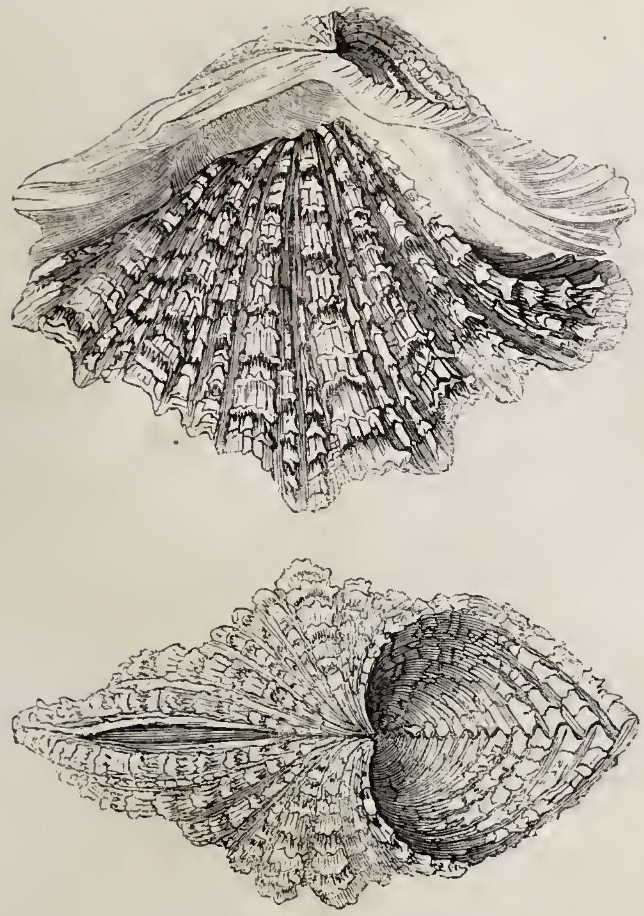
2939.—Calyculate Cardita.



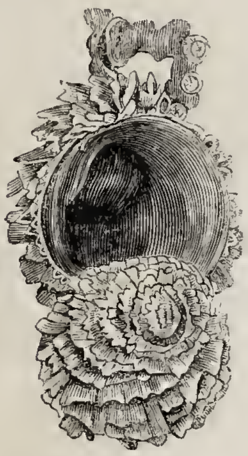
2950.—Pearly Trigonia.



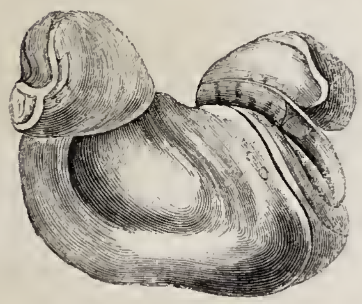
2944.—Tortuous Ark.



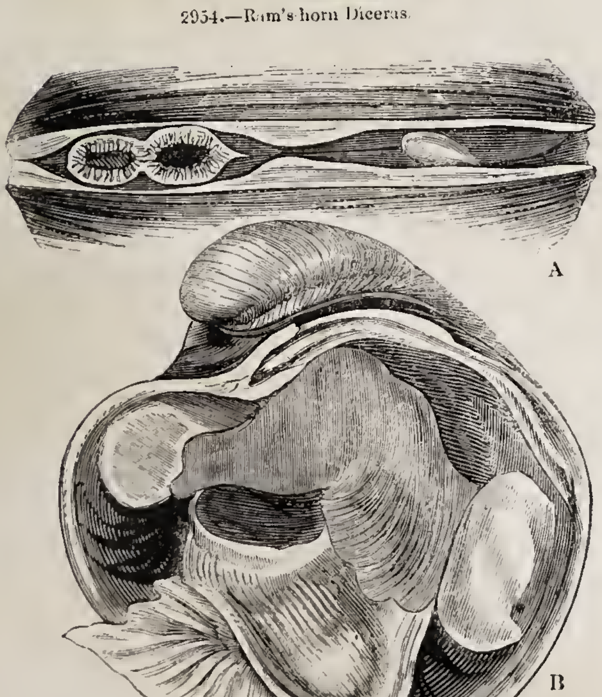
2952.—Spotted Tridacna.



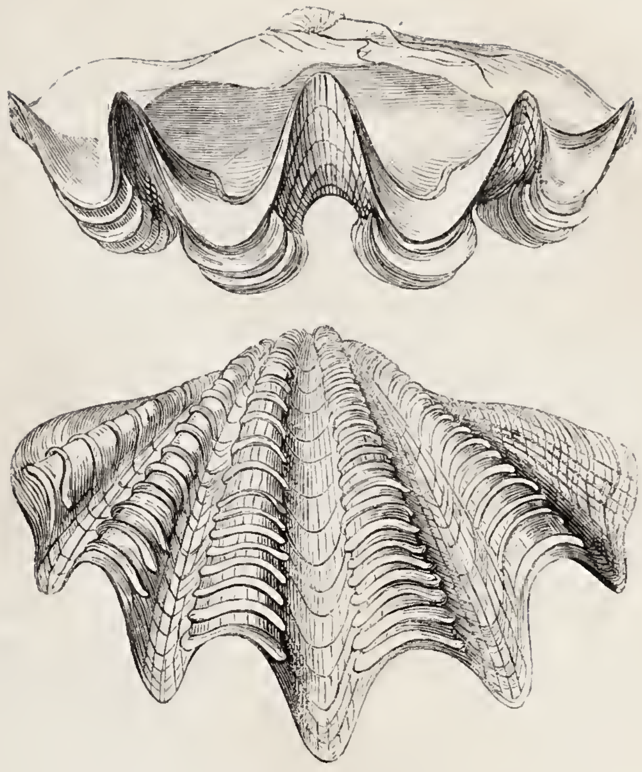
2953.—Gryphoid Chama.



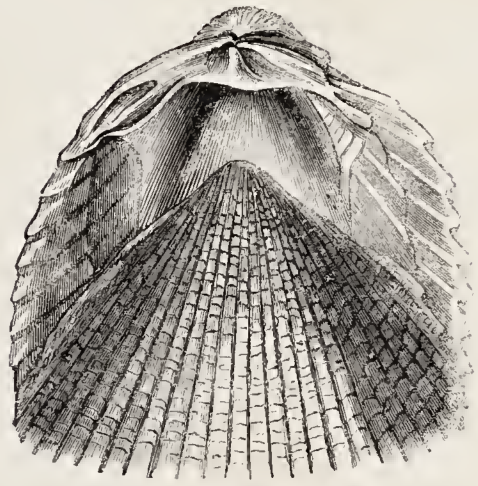
2954.—Ram's-horn Diceras.



2955.—Heart Isocordia.



2951.—Giant Tridacna.



2957.—Cardium elongatum.

2958.—Cardium Cardissa.

2956.—Heart Isocordia.

In Chama and Diceras, on the contrary, there are two adductor muscles, and the shells are adherent to rocks and stones, &c., generally by the flat valve. Still, it may be observed, that though the genus Tridacna (with the subgenus Hippopus, which, however, will not stand), is Monomyarian, it has no immediate affinity with the Monomyarian oysters, or Spondyli. The ligament of the hinge is external and marginal, and the hinge presents two unequal teeth; the mollusk in structure more nearly approaches that of Chama and of the Cardiidæ than any other. Accordingly M. Deshayes remarks that it may be advisable to follow the arrangement of Cuvier, who places the Tridacnæ in the neighbourhood of the Chamæ, as indeed had been previously done by Linnæus; for the Swedish naturalist places under his genus Chama both the Chamæ properly so called and the Tridacnæ.

With respect to Hippopus, M. Deshayes agrees with M. de Blainville, who is of opinion that this genus must be suppressed, the principal character of which, namely the closed lunule, is valueless, inasmuch as it does not coincide with the structure of the animal, which is similar to that of the animal of Tridacna.

M. Deshayes remarks that Lamarck would certainly not have separated Hippopus from Tridacna, if he had known that some Tridacnæ as they advance in age have the lunule much narrower than it is in youth, and had been acquainted with the animal of Hippopus, which is figured by M. Quoy in the 'Voyage of the Astrolabe' (pl. 80), and which differs in nothing from that of Tridacna, excepting that the foot is rather smaller and without a byssus.

M. Lamarck thus describes the characters of the shell of Tridacna :—Shell regular, equivalve, inequilateral, transverse, with a gaping lunule, (closed in Hippopus). Hinge with two compressed unequal and internal teeth; ligament marginal and external.

M. de Blainville modifies these characters, dividing the genus into two sections. Section 1 :—Species whose shell is more elongated and more inequilateral; the anterior part being longer than the posterior; the lunule widely open in youth for the passage of a byssus. Example, Tridacna Gigas. Section 2 :—Species more equilateral; the anterior portion shorter than the posterior, and forming a vast lunule entirely filled up; umbones curved forwards: a single post-cardinal tooth on each valve.

The mollusk is oval and cordiform, having the lobes of the mantle united nearly throughout their circumference, leaving three apertures—one anterior, corresponding in Tridacna gigas with the gape of the lunule, and giving passage to a thick byssiferous cylindrical foot; two posterior, one for the admission of water to the branchiæ, the other for the passage of the egesta. The mouth is oval, and furnished with large lips, at the extremity of which are two pairs of pointed labial palps.

These mollusks are natives principally of the Indian seas, and are found at various depths from the surface to seven fathoms.

2951.—The Giant Tridacna

(*Tridacna Gigas*). Giant Clam; la Tuilée, or le Bénitier, of the French. The shell is of huge size, transversely oval, with great imbricato-squamous ribs; the scales short, arched, and lying near together; the interstices of the ribs not striated.

This noble species, which is a native of the Indian seas, attains frequently to enormous dimensions; and often weighs from three to four hundred pounds. Linnæus mentions a specimen four hundred and ninety-eight pounds in weight.

A MS. in the library of the late Sir Joseph Banks gives the dimensions of a specimen brought from Sumatra, the weight of which amounted to five hundred and seven pounds. We have seen a shell of large size in the church of St. Sulpice, Paris, the valves of which are used as vessels for containing holy water; it was presented to Francis I., by the republic of Venice. We have also lately seen some very large valves set up as ornaments in a garden.

Of the strength of the cable, or byssus, by which a shell of the weight of four hundred pounds moors itself to the rock or coral reef, we may easily form some idea, and also of the force with which the animal closes its valves on the least alarm.

Cuvier, speaking of the byssus, says, "it is very sensibly of a tendinous quality, and is continued uninterruptedly by muscular fibres." Does not this statement seem to favour the ideas of M. de Blainville respecting the nature of the byssus, to which we previously referred in our introductory observations on the Conchifera?

The Tridacna Gigas, independently of its magnitude and weight, is a very beautiful shell. Its inside is of glossy whiteness, and its general form is very picturesque: hence it is sought for as an ornament for grottoes, for flower-gardens, and as a basin for garden fountains, or for the reception of rills, or little jets d'eau, which sparkle in its stainless hollow.

The naturalists of the Astrolabe found this species at Carteret Harbour, New Ireland. The natives brought many very large specimens on board, and ate the mollusks, which were abandoned to them, with the utmost relish, and without being previously cooked. They found the species again at Tongataboo, at the Moluccas, at Timor, and at Wagion. It appeared to prefer rather shallow water.

It would seem that there are several species, and some of large size, which have been confounded with Tridacna Gigas: certain small species, moreover, have been regarded as the young. These points have been cleared up by M. Deshayes.

2952.—The Spotted Tridacna

(*Tridacna Hippopus*). Hippopus maculatus, Lamarck; Tridacna maculata, Quoy; Chama Hippopus, Linnæus. This beautiful shell, often used for ornamental purposes, is a native of the Indian Ocean. It was found by the naturalists of the Astrolabe at Carteret Harbour, New Ireland; and also at Vanikoro, where they collected specimens left dry on the reefs.

It is solid and heavy, irregularly ribbed, and subsquamous. Externally it is white, spotted with purplish red, especially about the middle of the valves and towards the umbones: the lunule is cordate and oblique, of a yellow tint, with its edge on each valve toothed. The valves internally are of the purest white.

It appears to be very doubtful whether any fossil species of Tridacna exists. M. Deshayes, in his Tables, records two fossil and seven recent; in his last edition of Lamarck he reduces the number of fossil species to one. Mr. G. B. Sowerby, in his 'Genera,' states that Tridacna is only found recent, and in tropical seas, viz. those of India and Australia.

From the Monomyarian Tridacnæ, we pass to the genus Chama, as restricted by modern naturalists.

In the genus Chama the shell is irregular, with unequal valves, generally lamellated, and foliated or spined externally: it is found fixed to rocks and coral reefs, like the oyster. The umbones are distant, unequal, curled, or involute. The hinge presents one thick oblique and somewhat notched tooth, inserted into the groove of the opposite valve. There are two adductor muscles, leaving lateral impressions. The ligament is external.

The animal is somewhat cordiform; the two lobes of the mantle unite, leaving a narrow passage for the foot, and two short ciliated siphons, as we shall find in Isocardia. The foot is truncate and bent. It is generally by the upper valve that the Chamæ are attached, and the shape of the shell is affected by the pressure and form of the substances in contact with it.

In the first vol. of the 'Trans. Zool. Soc. Lond.' (1834) Mr. Broderip makes some interesting observations on the Chamæ, of which he describes ten new species, brought by Mr. Cuming from the intertropical shores of America and the islands of the Pacific Ocean. "The shells," he writes, "are attached by their external surface to submarine bodies, such as coral rocks; and shells have been observed at depths varying from points near the surface to seventeen fathoms. These shells appear to be subject to every change of shape, and often of colour, that the accidents of their position may bring upon them. Their shape is usually determined by the body to which they are fixed; the development of the foliated laminæ which form their general characteristic is affected by their situation; and their colour most probably by their food and their greater or less exposure to light. The Chama that has lived in deep and placid water, will generally be found with its foliations in the highest state of luxuriancy; while those of an individual that has borne the buffeting of a comparatively shallow and turbulent sea, will be poor and stunted.

Lamarck has divided the species into two sections, viz. first, those the umbones of whose shells turn from left to right; and secondly, those whose umbones turn from right to left. M. Sander Rang, in his 'Manuel,' has adopted this division, to which I cannot subscribe, because it will not bear the test of observation. Two remarkable instances are now well known of regular bi-valves of the same species, in which one specimen may be regarded as being the reverse of the other; viz. Lucina Childreni, and an inequivalve Mytilus in the British Museum: and to come at once to the case before us, the same species of Chama is sometimes attached by the right, sometimes by the left valve; or in other words, in one individual of the species the umbones will turn from left to right, while in another individual they will turn from right to left."

From these observations it may be inferred that the difficulty of determining the species is not inconsiderable. The Chamæ are almost exclusively confined to the hotter seas; some however occur in the Mediterranean.

2953.—The Gryphoid Chama

(*Chama gryphoides*). This is one of the Mediterranean species: it is not uncommon in collections.

The number of recent species is about thirty. The fossil species are abundant: they occur in the supracretaceous groups, particularly in the sub-Apennine beds, and those of Bordeaux and Dax; in the cretaceous group, and also in that of the oolite. Mr. G. B. Sowerby states that they are found in the London clay, the calcaire grossier, the chalk, and green-sand; and M. Deshayes enumerates twenty species as occurring in the Pliocene, Miocene, and Eocene (tertiary) periods,—of these four are living species as well as fossil.

From Chama we turn to the genus Diceras, if indeed it be distinct from Chama.

Cuvier says Diceras differs from Chama in nothing essential; the cardinal tooth is indeed very thick, and the umbones (les spirales) of the valves project in such a manner as to bear a resemblance to two horns. It is on these points that Diceras is separated by Lamarck and others from Chama, while others, as M. Bruguière and M. Deshayes, merge it into Chama. The latter, in his edition of Lamarck (see note), says, "In comparing the young Dicerata with the Chamæ, there is no difference worthy of note; but it must be added that in proportion as the shells of the Diceras increase in age, the characters of the hinge become more and more exaggerated, yet without such an alteration as renders them entirely dissimilar to what they were in their youth. It may be said, then, that in reality the Dicerata are only Chamæ exaggerated in their volume, their thickness, the prominence of their umbones, and the size of their cardinal teeth.

There would not then be any inconvenience, in uniting the two genera, forming for each of them a section, which would thus have less value than a genus established for each.

2954.—The Ram's-horn Diceras

(*Diceras arietina*). Diceras arietinum. This species, and the few that are known, are all fossil, from the Jura beds (terrains Jurassiques). M. Defrance enumerates five species, but M. Deshayes, in his last edition of Lamarck, refers only two species (D. arietina, and D. sinistra) to the present genus or section; the former from Mont Salève and the neighbourhood of St.-Mihiel, the latter from the upper oolite in the vicinity of the last-named place.

A very beautiful and interesting form, constituting the genus Isocardia, next demands attention.

Linnæus considered this form as coming under his genus Chama, and M. de Blainville between Tridacna and Trigonia.

Although the shell is free, never being attached to rocks, we cannot help regarding it as allied to Chama and Diceras, while at the same time it approaches the Cardiidæ, or cockle tribe. Bruguière ranged it with the Carditæ, but, as M. Deshayes observes, Isocardia differs from Cardita both in the structure of the shell and the mollusk. In Cardita the lobes of the mantle are separated throughout their length and are without siphons. In Isocardia the lobes of the mantle are united posteriorly, and provided with two short siphons or orifices, which may be compared with those of Cardia. In Tridacna, as we have already observed, there are two short ciliated siphons, resembling those of Isocardia.

Cuvier says, "The Isocardiæ have the shell free, regular, and convex, with umbones spirally convoluted, and divergent. The mollusk does not differ from that of Chama, excepting that the foot is larger and oval, and that the anterior opening of the mantle begins to assume its ordinary extent. The Mediterranean presents us with one species, of considerable size, smooth, and rufous, Chama Cor, Linn."

The generic characters are as follows :—

The shell is sometimes covered by an epidermis, it is very convex in form, globular, heart-shaped, equivalve, but inequilateral; the umbones are divaricated, widely divergent, curved forwards and outwards, and slightly spiral; the hinge presents two flattened teeth; ligament external and forked; muscular impressions distant; the mollusk has the borders of the mantle fringed with fine tentacular papillæ; posteriorly there are two very short siphons

surrounded by papillæ, one (the more central of the two) for respiration.

The number of living species is very limited, M. Deshayes enumerating only eight as living and fossil (last edit. of Lamarck).

The recent species are found in the European seas, and those of India and Australia.

2955, 2956.—THE HEART ISOCARDIA

(*Isocardia Cor*). Chama Cor, Linn. Referring to Fig. 2955, A represents the animal as it appears between the partially opened valves; the two ciliated siphons are visible, the edges of the mantle, and a portion of the foot; B shows the animal in one of the valves; the large sharp-edged foot, and the two muscular surfaces, are well seen; the mantle is cut away to a great extent. Fig. 2956 shows the beautiful shell of Isocardia Cor with the valves closed.

This species is a native of the Mediterranean and other seas of Europe. In the 'Zool. Journal,' vol. ii. p. 359, will be found some observations on the present mollusk by the Rev. James Bulwer, who studied the habits of the species from some specimens trawled up in deep water on the east coast of Ireland. These he put into a vessel of sea-water for examination. The shell opened, as at A, Fig. 2955, and the feelers or cilia of the anterior siphon (the respiratory siphon), the largest of the two, moved slowly as if in search of food. Having remained in this situation about ten minutes, water was ejected with considerable force from the posterior orifice, which had till then remained motionless. The expulsion of the water appeared to be effected by a sudden contraction of the muscles, because this was never done without the valves nearly closing at the same instant. After a few seconds the valves gradually returned to their open position, and remained quiescent as before, till the water was again ejected with a jerk. This alternating process was repeated during the whole time his specimens were under examination, but at shorter intervals on receiving fresh supplies of sea-water. The animal appeared to Mr. Bulwer to be insensible both to sound and light; its sense of feeling, on the contrary, appeared to be exquisitely susceptible; minute substances dropped into the orifice of the mantle instantly excited the animal, and a column of water, strongly thrown out, expelled them from the shell. With so much force was the water in some instances ejected, that it rose above the surface of three inches of superincumbent fluid. Its movements, however, were interrupted neither by the presence or absence of light, nor by noises however loud.

Leaving Isocardia within the pale of the Chamidæ, we pass to another and extensive group.

Family CARDIIDÆ (COCKLE, MACTRA, &c.).

Cuvier institutes a great section, or, as he terms it, family, of the acephalous bi-valve mollusks, to which he gives the title of Les Cardiacés, equivalent to the family Conchacea of M. de Blainville. Of this section Cuvier gives the following general characteristics: "In all the mantle is open anteriorly, but posteriorly it presents two siphons or orifices, one for respiration, the other for the egesta. These form tubes sometimes distinct, sometimes united into a single mass. There is always a transverse adductor muscle at each extremity of the shell, and a foot which generally serves for the purpose of locomotion. It may be laid down as a rule, that the species with elongated siphons live buried in the mud or sand. This condition of organization may be recognised on the shell, by the more or less developed contour which the impression of attachment of the borders of the mantle describes, before uniting with the impression of the posterior transverse muscle." The Conchacea of De Blainville are equivalent to the order Phyllopoda of Mr. Grey, which he divides into the families Veneridæ, Cyrenidæ, and Cardiidæ.

Of these families, instituted by Mr. Grey, referring them as subfamilies to the Cardiidæ, or Conchacea, we shall select a few prominent examples.

The first genus to be noticed is Cardium, of which the well known cockle (Cardium edule), la Coque or Sourdon of the French, is known to all. The cockles, like many other bi-valves, have an equivalve shell, subglobular and cordiform, with umbones convoluted towards the hinge; the hinge is formed by four teeth in each valve, two cardinal and oblique, two lateral and distant; the valves have radiated ribs and toothed borders.

The animal is furnished with a very large cylindrical foot, bent elbow-like about the middle, directed forwards, and terminating subconically; the lobes of the mantle, bordered inferiorly by tentacular papillæ, are united posteriorly with two very short siphons or mere apertures, ciliated around the margin; mouth transverse with small appendages. These shells are very widely distributed, the seas of almost every warm and temperate climate abound with them, and one species at least (Cardium radiatum), brought home by Captain Parry, is a native of the Polar Ocean. In the 'Proceeds. Zool. Soc.' 1833, will be found descriptions of fourteen new species, by Mr. W. B. Sowerby, and of one by Mr. Broderip; they were brought home by Mr. Cuming from the western coast of South America and the islands of the South Pacific Ocean.

The cockle tribe generally live on sandy shores, at a depth varying from the surface to thirteen fathoms. They bore into the sand by means of their powerful foot, which enables them also to leap with considerable vigour. Many species attain to a considerable size.

Fig. 2957 shows the characters of the valves and hinge of Cardium elongatum.

From the genus Cardium may be separated into a subgenus, under the name of Hemicardium, such species as have the valves compressed from before backwards, and strongly keeled down the middle. It would be strange, says Cuvier, if the animal did not present some modification in accordance with this singular configuration. M. Rang corroborates Cuvier's observation, from the examination of living individuals of Cardium (Hemicardium) Cardissa. M. Deshayes, however, considers that the form can only be admitted as a section.

Fig. 2958 represents the Cardium (Hemicardium) Cardissa, of the natural size; a spotted variety.

Of the living species of the Cardium about fifty are known, and between thirty and forty of fossil species; the latter occur in most of the fossiliferous strata, from the cretaceous to the grauwacke group, and appear to be most abundant in the crag, the London clay, the green-sand, and the contemporaneous beds.

We next turn to the genus Capsa. In this genus the shell is transverse, equivalve, inequilateral, and not gaping; the cardinal teeth diverge from a point close to the umbo; in one valve there are no lateral teeth, in the other one distinct cardinal tooth, and two distant, very obsolete, lateral ones; ligament external; a large sinus in the pallial impressions.

The animal has the mantle considerably open at its marginal border for the passage of a very compressed and large foot; the siphons are separated and of considerable length, with tentacular papillæ at their orifices.

The shells of this genus are natives of the warm and temperate seas; they lie buried at a small depth in the sandy mud, with the posterior part upwards to facilitate the influx of water for respiration. The depth at which they are found varies from five to twelve fathoms from the surface of the water.

2959.—THE BRAZILIAN CAPSA

(*Capsa Brasiliensis*). Of the genus Capsa M. Deshayes only records two species, viz. the Brazilian Capsa and the Capsa lævigata; and he considers that the genus should be suppressed and referred to Donax. In the 'Proceeds. Zool. Soc.' 1832, a species from Peru and Central America is described by Mr. G. B. Sowerby, under the title of Capsa altior. The inside of the valve of Capsa Brasiliensis shows the two muscular impressions, and the form of the pallial impressions, as well as the characters of the hinge.

With respect to the genus Donax, these shells have the hinge nearly as in Cardium, but their shell is of a different form, being triangular, with the obtuse point at the umbones of the valves and the base of the triangle at their margin; the shortest side is that which presents the ligament, viz., the posterior part of the shell, a circumstance rare among bivalves, which have in general the posterior part of the shell the longest. It may, however, be repeated that many call the portion of the shell which has the ligament the anterior, and the part which presents the lunule the posterior, of the shell, reversing the valves entirely; and accordingly Mr. G. B. Sowerby says, "Lamarck is at issue with himself when he calls the ligament posterior in Donax; for the sake of consistency we must continue to call the side on which the ligament is placed, as well as the sinus on the muscular impression on the mantle, whether it be the shorter or longer, the anterior side. We are aware that Cuvier has pointed out the impropriety of this; but the term anterior is generally adopted for the side (end) which bears the ligament, and the posterior for the opposite side (end)."

M. Deshayes, in his edition of Lamarck, well observes that the terms anterior and posterior, as used by that zoologist, are badly applied, and that it must not be concluded, as some have done, that the Donaces and Tellinæ have the ligament on the anterior side. Adanson, he remarks, has doubtless assisted in confirming the error that the former have the ligament placed on the anterior side; for, probably through inadvertence, in representing the animal of Donax, he makes the foot protrude from the short end, which bears the ligament, and the siphon from the long end of the shell, thus reversing the animal in the valves. The fact is that in Donax, as in the rest of the Conchifera, the anterior and posterior part of the shell, and the left and right valves, may be determined by placing the shell on edge, with the ligament posteriorly; this will make the long acute end in Donax the anterior (whereas in most the lunular or anterior end is the shortest), and the end whence the siphons are protruded, viz. the posterior, the shortest.

In general the Donaces are small shells prettily striated; the umbones are but little prominent, and nearly vertical; the foot is compressed and angular, and there are two siphons, capable of being retracted into a sinus of the mantle.

The genus is widely extended, species existing in all seas. Several are natives of the European coasts. They lie buried in sand and sandy mud, with the posterior, or (in them) the short end, of the shell uppermost, for facilitating the entrance of water through the respiratory siphon.

Fig. 2960 represents the hinge and inside of the valves of Donax Scortum. The fossil species of this genus are not very numerous. They are said to occur principally in blue marls in the south of France, and in the oolitic series.

The genus Gratelupia, on the contrary, occurs only in a fossil state. Two species are recorded one, the Gratelupia donaciformis, from the marine tertiary beds of Merignac, the other, G. Moulinsii, from Claiborne, Alabama (America), in tertiary strata of the same period, according to Mr. Lea, as the London clay and the calcaire grossier of Paris.

Figs. 2961 and 2962 represent the Gratelupia Moulinsii, and convey a clear idea of the characters of the genus.

Our next genus for inspection is Tellina, which in some respects agrees with Donax. The shell is elongated and compressed, regular and sometimes slightly inequilateral: the anterior side is sometimes, but not always, longer than the posterior, which latter is often angular with a flexuous and irregular bend at its lower border; the umbones are small; the hinge presents three cardinal teeth, and two lateral ones, which are often distant, with a hollow at their base in each valve.

In the mollusk the tubes are very much elongated and separated, and capable of being withdrawn into a fold of the mantle.

The genus Tellina is widely spread, but is most abundant in the warmer seas. Like the Donaces, these shells bury themselves in the mud, and in beds of sand, often at the depth of sixteen or seventeen fathoms. The species are very numerous, upwards of sixty being described.

Fig. 2963 represents the Tellina rostrata, which may be regarded as a fair example of the genus.

From the genus Tellina M. Lamarck separated such species as are rather rounded or oblong in contour, the valves presenting no decided flexuous bend, the hinge having two divergent cardinal teeth, and two distant lateral ones, of which the anterior is but little distant from the umbo. For these species he founded the genus Tellinides.

This genus is admitted by Mr. G. B. Sowerby, but not by MM. Rang, De Blainville, or Deshayes. It may be retained, however, if only for the sake of convenience. Mr. Sowerby observes that the number of shells which may be ranged under it is rather considerable, although Lamarck has only mentioned one. The species referable to Tellinides inhabit the same sea and display the same burrowing habits as those of Tellina.

Fig. 2964 represents the inside of one of the valves of Tellinides.

Of these two genera, granting this rank to Tellinides, there are not many fossil species. Deshayes, in his last edition of Lamarck, gives only sixteen, though previously in his table he had enumerated fifty-four. Four fossil species are to be added, which were collected by Mr. James Burton from the western borders of the Red Sea.

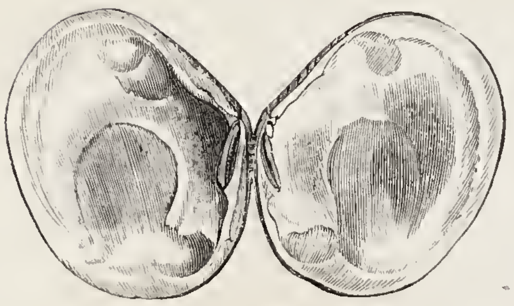
Another genus founded by Lamarck is Amphidesma, which M. Deshayes remarks is not very natural, but may be retained till it has undergone the necessary scrutiny and reform.

The shell is suboval, of little thickness, inequilateral, sometimes a little gaping; the hinge presents one or two cardinal teeth, and sometimes lateral teeth. Ligament double; one portion external, the other internal.

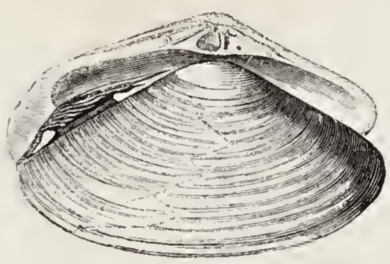
The genus is widely spread, occurring in the European seas (English Channel, Mediterranean, &c.), those of South America, New Holland, &c. They are found in sands and mud, sometimes as deep from the surface as forty fathoms. Lamarck enumerates sixteen species; to these must be added twelve new ones described by Mr. Sowerby in the 'Proceeds. Zool. Soc.' for 1832, from specimens brought by Mr. Cuming from the western coast of South America and the islands in the South Pacific Ocean.

2959.—Brazilian Capsa.

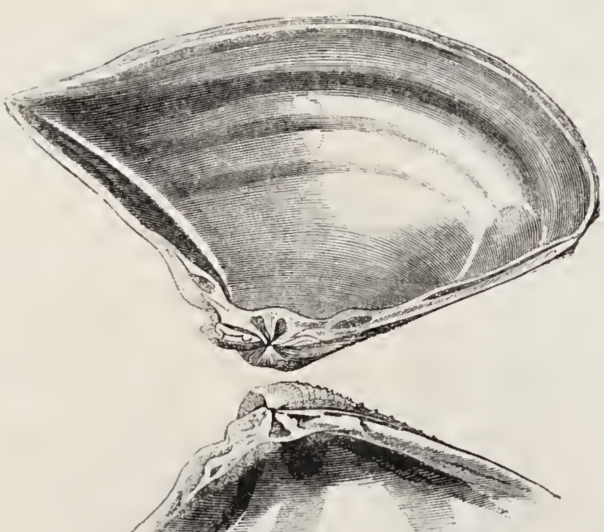
2966.—Earless Cumingia.



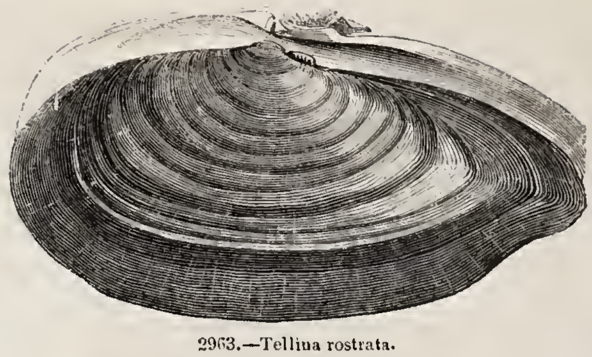
2965.—Variegated Amphidesma.



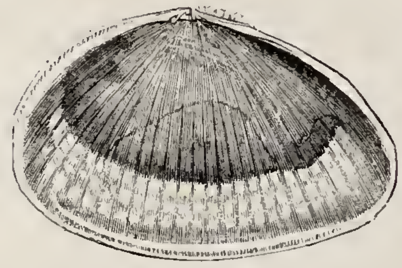
2967.—Brazilian Mactra.



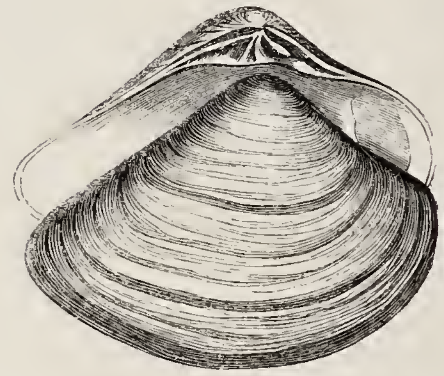
2960.—Donax Scortum.



2963.—Tellina rostrata.



2964.—Telliuides.

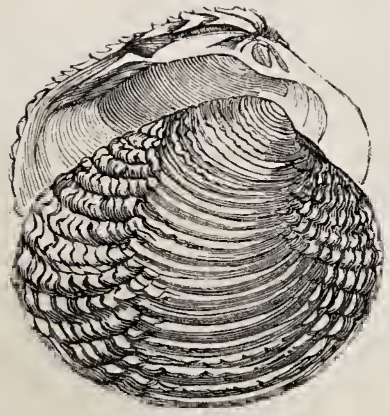


2961.—Gratelupia Moulinsii.

2962.—Gratelupia Moulinsii.

2968.—Common Crassatella.

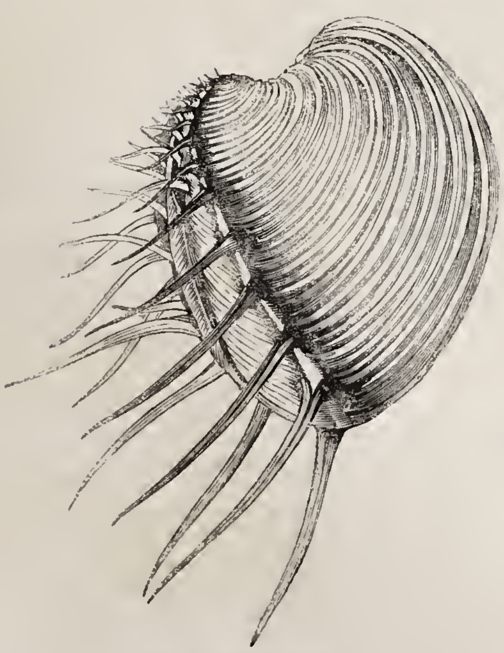
2974.



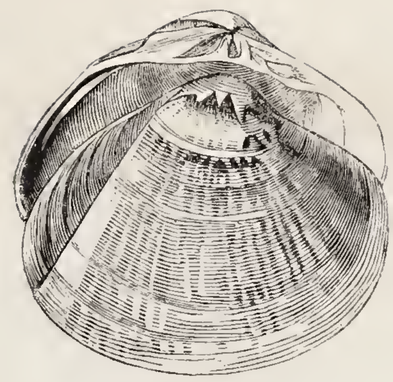
2974, 2975.—Cancellated Venus.

2976.—Patern-shot Venus.

2977.—Common Venus.



2971.—Spined Cytherea.



2973.—White Cytherea.

2970.—Common Cyprina.

2969.—Dusky Cyrena.

2972.—Spined Cytherea.

2965.—The Variegated Amphidesma

(*Amphidesma variegatum*). The species described by Lamarck is a native of the coast of Brazil.

With respect to the fossil species five are recorded by Phillips in the oolite group. Dr. Fitton describes and figures one as doubtful, from the green-sand; and Mr. Lyell records another found at Caltagirone.

Closely allied to Amphidesma, is the genus Cumingia, founded by Mr. G. B. Sowerby, and which he says is remarkable for the dissimilarity of the hinge of the two valves, one having a strong lateral tooth on each valve, the other being almost destitute of lateral teeth. "Having," says Mr. Sowerby, "only met with a single West Indian species, I did not venture to consider this genus established, until Mr. Cuming showed me several species in his rich collection of South American and Pacific shells, one of which is sufficiently large to show the characters distinctly." ('Zool. Proceeds.' 1838, p. 34.)

To this West Indian species must be added four species described in the above 'Proceeds.' 1833, of which one is the Cumingia mutica.

2966.—The Earless Cumingia

(*Cumingia mutica*). Mr. Sowerby says that the ligament of the hinge is internal in this genus, and affixed to a somewhat ear-like pit or depression (ligamento interno, foveolæ subcochleariformi affixo). The present species he describes as having an oval shell, very minutely decussated, rounded anteriorly, posteriorly rather acute. It was obtained at the following places: Conception, in seven fathoms, on sand and mud; at Iquiqui, in nine fathoms, on gravel and mud; at Payta, in hard clay at low water; and at Muerte.

The other three species are C. lamellosa, from Payta and Panama; C. coarctata, from the Bay of Caracas; and C. trigonularis, from St. Elena. No fossil species as yet known.

We now turn to the genus Mactra; the distribution of which is very extensive, ranging through the seas of Europe, the East and West Indies, Africa, North America, &c.

The shell is transverse, inequilateral, subtrigonal, sometimes a little gaping at the sides; the umbones are protuberant; the hinge has one cardinal tooth in the form of the letter V, the point being nearest the umbo, and the branches diverging from it; close to this is a very sharp thin tooth. Lateral teeth two on each side in one valve, one on each side in the other.

The mollusk is rather thick and oval; the borders of the mantle are simple, with two siphons, but little elongated, and united. The foot is very long and angular.

The genus Mactra contains a very extensive series of species; some of singular form, others remarkable for beauty; they mostly live on sandy mud, and sands, at depths varying from the surface of the sea to ten or twelve fathoms. The living species are about thirty in number.

M. de Blainville divides them into the following subgeneric groups:—

1. Species whose cardinal teeth become nearly obliterated, in consequence of the enlargement of the ligamental depression. Example: Mactra gigantea.

2. Species all of whose teeth are very large, lamellar, and not striated. Example: Mactra stultorum.

3. Thick and solid species without an epidermis; the lateral teeth finely striated; the mantle pierced with two openings, but almost without siphons. Example: Mactra trigonella.

4. Very thick, solid species, striated longitudinally; cardinal teeth none, or next to none; lateral teeth very thick, approximated, raised; an external ligament besides the internal one. Example: Mactra crassa.

2967.—The Brazilian Mactra

(*Mactra Brasiliana*). This species from South America may serve to represent the genus; it is not rich in fossil species, which Mr. G. B. Sowerby says are only to be found in tertiary beds, unless some very singular fossils found in the secondary strata, particularly the oolite, be truly referable to this genus; of this, however, we cannot be certain, because we know not their hinges. They will be found represented in Sowerby's 'Mineral Conchology.'

The genus Crassatella now presents itself. In this genus the shell is equivalve, transverse, and inequilateral. In one valve there are two strong cuneiform, rugose, cardinal teeth, sometimes perpendicularly grooved; in the other there is only one.

The ligament is internal, and attached to a convex space placed on the anterior side of the hinge; the pit, however, is divided into two portions, and that part of the ligament attached to the outer portion is visible externally when the valves are closed. The muscular impressions are very distinct; pallial impression simple, not sinuous.

The species are found on the coasts of central and South America, and in the seas of Australia.

2968.—The Common Crassatella

(*Crassatella Kingicola*). We select this species as a representative of the genus, which contains ten or twelve recorded species, including two described by Mr. G. B. Sowerby in the 'Proceeds. Zool. Soc.' 1832, p. 56, both from the shores of America, where they were dredged up from sandy mud in eleven fathoms of water.

Fossil species occur in the calcaire grossier of Paris, in the London clay, and, according to M. Defrance, also in the lower chalk—but with respect to these some doubt exists.

The following genera, more or less immediately allied to the genus Venus, constitute a subfamily or section of the Cardiidæ, in part the Veneridæ or Venerinæ of some writers. Mr. Gray, who recognises a family *per se* in the Veneridæ, places as the first in his order Phyllopoda, to which succeeds the family Cyrenidæ, and next the family Cardiidæ; thus establishing three families out of the Cardiacés of Cuvier, or the Conchacea of De Blainville. The latter divides his Conchacea into the following sections:—

1. Regular Conchacea with the lateral teeth distant. Genera Cardium, with its subdivisions; Donax, and Tellina, with its subdivisions; Cyclas, with its subdivisions; Cyprina, and Mactra, with its subdivisions; and Erycina.

2. Regular Conchacea without lateral distinct teeth. Genera Crassatella and Venus.

3. Irregular Conchacea.

Genera Venerupis, with its subdivisions; Corallиophaga, Clotha, Corbula, with its subdivisions; Sphæna, and Ungulina.

As, however, it is not our plan to enter minutely into the arrangements of various writers, we shall at once proceed to the genera of which our pictorial specimens are representatives.

And first the genus Cyrena:—Cuvier places the genus Cyrena (and also Cyprina) as closely related to Cyclas. The Cyrenæ, he observes, are natives of rivers, as are also the Cyclades; the shell is thick, somewhat triangular, and oblique, and covered with an epidermis: it is distinguished from Cyclas by having three cardinal teeth, instead of two. The mollusk, which differs little from that of Cyclas, has the two lobes of the mantle united at their posterior third, and prolonged by two retractile siphons separated to the base.

2969.—The Dusky Cyrena

(*Cyrena fuscata*). This species is described by Lamarck as a native of the rivers of China and those of the Levant. It is of a brownish green colour, with numerous transverse subimbricate furrows. The umbones and the inside of the valves are violet coloured; the lateral teeth are much elongated transversely, and denticulated.

M. Deshayes, in his last edition of Lamarck, enumerates fifteen recent and twelve fossil species.

With respect to the genus Cyprina, it is closely allied to Venus. The hinge has three unequal teeth, approximated at the base, subdivaricate above; a lateral tooth distinct from the hinge, but sometimes obsolete.

M. Deshayes remarks that Cyprina may be distinguished from Venus by the following points:—The mollusk of Cyprina has the two lobes of the mantle united posteriorly, and they terminate on that side in two very short siphons, or rather in two perforations resembling those in Cardia. These siphons are too short to require a retractor muscle, and for this reason the impression of the mantle is always simple in true Cyprinæ. In the Veneres the animal furnished with longer siphons is provided with a retractor muscle which produces a more or less deep inflection of the pallial mark. Moreover, on all the Cyprinæ there ought to be a posterior lateral tooth on the border below the termination of the ligament. The species are found in sandy mud, at the mouths of rivers.

2970.—The Common Cyprina

(*Cyprina vulgaris*). This species, synonymous with or a mere variety of the Cyprina Islandica, is found at the mouths of rivers in the Northern Ocean. It is cordate in shape, transversely striated, and covered with an epidermis. It occurs also in a fossil state. The number of recent species, according to M. Deshayes, is two; of fossil seven; but three species are recorded by Dr. Fitton below the chalk, which have to be added.

We now turn to the genus Cytherea, which is a mere subgenus of Venus: the hinge presents four cardinal teeth in one valve, of which three are divergent and one isolated; and three cardinal teeth in the other valve. In Venus there are only three teeth in each valve.

Lamarck states that in Cytherea there are constantly four teeth in the hinge, and that the fourth tooth is very oblique, and always set in that part of the border which comprises the lunule. In many species this tooth is indeed constant, but in more than twelve living and fossil species, which M. Deshayes carefully examined, he traced a gradual diminution in this tooth, till at length it became merely rudimentary; and he adds, that having in this rudimentary stage escaped the notice of M. Lamarck, the latter placed many species belonging to his Cytherea, in the genus Venus. Where, then, asks M. Deshayes, is the division line to be drawn, and what reasonable ground exists for the separation of the two genera? The same question may be asked respecting half of the genera in every department of zoology; seldom are they founded on philosophical principles, and seldom have they the same relative value.

Of the genus Cytherea, M. Deshayes in his Tables enumerates eighty-five living species and fifty-nine fossil; but in his last edition of Lamarck he reduces the number of living species to seventy-eight, and of fossil species to nine. To the latter are to be added six species described by Mr. Lea from the tertiary beds of Alabama, and six from beds below the chalk, enumerated by Dr. Fitton.

2971, 2972.—The Spined Cytherea

(*Cytherea Dione*). Venus Dione, Linnæus. This beautiful shell from the seas of America is remarkable for the row of spines on the posterior borders of each valve; in some individuals they are long and distant, in others close-set and short. The valves are transversely furrowed with elevated lamellæ. In colour these species differ considerably; some species are roseate, others vinous, others more or less tinged with purple.

2973.—The White Cytherea

(*Cytherea meretrix*). In this species the valves are smooth and white, with the posterior margin tinged with purple; the umbones are spotted with brown: some varieties are more or less marked with chestnut.

Of the genus with three cardinal teeth in each valve, to which the term Venus is mostly restricted, we may adduce the following example:—

2974, 2975.—The Cancellated Venus

(*Venus cancellata*). We figure two varieties of this shell, which is girt with elevated transverse belts. The colour is white, spotted with bay or brown; the lunule cordate. It is a native of the seas of America.

The species of Venus are very numerous, and, though occurring in most seas, are chiefly natives of the warmer latitudes, and are generally to be found at a moderate distance from the shore.

From the genus Venus has been separated a group to which the term Pallastra has been applied; the genus thus named reposes, says M. Deshayes, on characters of minor importance than Cytherea. The shell is delicate, with three narrow and approximated teeth on the hinge of each valve; but there is no clear line of division to separate Pallastra from Venus.

2976.—The Pattern-shot Venus

(*Venus [Pallastra] textile*). This beautiful shell, reminding us of some zigzag patterns, the produce of the loom, is a native of the Malabar coast: the shell is ovate, smooth, and of a pale yellow with purplish scribbled or zigzag lines.

2977.—The Common Venus

(*Venus vulgaris*). Pallastra vulgaris. It is very probable that this species really belongs to the genus Venerupis.

A distinct genus which we may just notice is Lucina of Bruguière; in which the shell is suborbicular, with small pointed oblique umbones and two divergent cardinal teeth (one bifid), which are variable, and disappear with age. There are two lateral teeth.

The number of recent species is about twenty: but of fossil species about sixty-five are enumerated; some occurring in strata below the chalk, others in tertiary formations.

With respect to the following genera, we are by no means clear that they all belong to the present family. Most of the species are borers by habit, piercing stones and masses of coral, in which they reside. They constitute the family Lithophages (Lithophagidæ) of Lamarck.

The first genus to be noticed is Venerupis (or Venerirupis), the shell of which is described by M. Rang as solid, striated, or radiated, a little elongated, and gaping posteriorly; the anterior side is shorter than the posterior, which latter is generally

more or less truncated. The hinge presents two slender teeth in one valve, and three in the other.

The mantle of the mollusk forms two rather long posterior siphons with radiated orifices.

The mollusks which compose this genus are lithophagous, and excavate galleries in stones and madrepores; these galleries are more or less proportioned to the size and form of the shells, and in these they live: they are without an epidermis, and their colour is generally of a dirty white.

Mr. G. B. Sowerby, who is disinclined to admit of any marked distinction between Venus (or the subgenus Pallastra) and Venerupis, says, "It is well known that Venus perforans of Montfort (Venerupis perforans, Lam.), and some of its congeners, live in cavities perforated in chalk and limestone rocks; and that Venus Pallastra, and V. decussata, and several other species that resemble them in form and appearance, are found buried in the sand: an apparently well marked difference therefore exists in the habits of their respective animals.

We think, however, that we have evidence to prove that there exists in reality very little difference, and that the cavities in which Lamarck's Venerupes live are rather the natural consequence of the action of the sea-water, in conjunction with some of the excretions of the animal upon the chalk or limestone, than of any power of the animals themselves to pierce independently of such action; so that the difference is really only in the nature of the shore on which the very young shells are accidentally deposited, those which are thrown upon a sandy bottom burying themselves in the sand, and such as are deposited upon limestone or chalk producing a cavity in which they live." Mr. Sowerby then proposes to unite under one genus the Venerupes of Lamarck, and several species of Venus, as V. textile, V. Pallastra, &c.; for which genus he proposes the name of Pallastra, rejecting altogether that of Venerupis. We have already adverted to two species of Venus, which are assigned to Pallastra, and noticed the views of Deshayes respecting the genus.

MM. de Blainville and Rang restrict the genus Venerupis to the rock-boring species.

Its range is very extensive; many species occur on the shores of Europe and in the South Seas.

2978.—The Boring Rock-Venus

(*Venerupis perforans*). This species is found on the coasts of England and the adjacent continent. It is subject to some variety. *a* represents the shell from a figure by Montagu; *b*, the shell from nature. About eight species are known living and six fossil.

We now turn to Petricola, into which Mr. G. B. Sowerby merges the genus Ruppellaria.

Though Mr. Sowerby is inclined to bring the genus Petricola close to the Pholadariæ, yet it must be confessed that the animals differ but little from those of Venerupes, to which they approximate also in the form of the shells; indeed M. Deshayes remarks that hereafter we shall probably be obliged to unite Petricola and Venerupis, which in reality exhibit but trifling distinctions; and this resemblance exists not only in the shells, but also in the inhabiting mollusks.

Mr. Garner, in his anatomical classification of the Lamellibranchiata, makes no mention of Petricola, which he probably regards as identical with Venerupis, to which he devotes a considerable space.

The Petricolæ are widely spread, and are rather numerous on the coast of the warmer regions of America: they live in cavities of the rock formed by their own agency, and which are adapted to the shape of the shell itself, proving that in the work of boring the rock there is no rotatory motion.

The species vary considerably in the degree to which the shell is lengthened posteriorly. Figs. 2979 and 2980, Petricola pholadiformis; Fig. 2981, Petricola dactylus; Fig. 2982, Petricola ochroleuca; Fig. 2983, Petricola rupestris; Fig. 2984, Petricola subglobosa.

Eleven recent species of this genus are recorded by Lamarck and Deshayes, to which must be added ten new species, from the western coast of South America and the islands of the South Pacific, described by Mr. G. B. Sowerby, in the 'Proceeds. Zool. Soc.' 1839, pp. 46, 47. Many were found in hardened clay and mud at low-water, some in stones, and one in mother-of-pearl shells.

Several fossil species are recorded, some from strata below the chalk, others in tertiary deposits.

M. de Blainville took from the genus Cypricardia of Lamarck some species which he regarded as approximating to Venus, and formed them into a genus, to which he gave the name of Coralliophaga.

The shell is oval, elongated, and finely radiated from the summit to the base; the form is cylindrical and equivalve. The hinge presents two small cardinal teeth, one of which is slightly bifid, in front of a sort of lamellar tooth, under a weak external ligament. Pallial impression flexuous posteriorly.

The mollusk is not known, but most probably has elongated siphons.

2985.—The Cardite Coralliophaga

(*Coralliophaga carditoidea*). Cypricardia coralliophaga, Lamarck; Cardita coralliophaga, Brug.; Chama coralliophaga, Gmel.

This species is found often in abundance in the masses of madrepore and other corals at St. Domingo and the Antilles. We may here observe that M. Deshayes refers these shells to the genus Crassina.

The next genus, Clotho, exists only in a fossil state, no recent living species being known.

The shell is oval, equivalve, and longitudinally striated; the hinge presents a bifid tooth curved back into a hook-like form, rather longer in one valve than the other.

2986.—Faujas's Clotho

(*Clotho Faujasii*). This species, the only one recorded, was detected by Faujas in the fossil shells of certain species of Cypricardia, which were found imbedded in the stone which, when alive, they had eroded. The upper figures represent the shell of the natural size; the lower figures (*a*) represent it magnified.

We may now advert to the genus Ungulina, first established by Daudin, and adopted by Lamarck.

The animal is unknown. The shell is described by M. Rang as longitudinal, or transverse, irregular, not gaping, equivalve, subequilateral; the umbones tolerably developed and eroded. The hinge presents a cardinal tooth in each valve, short and subbifid, and an oblong marginal furrow or depression divided into two parts by a contraction: the ligament is subinternal, and inserts itself in these furrows. The muscular impressions are elongated; the pallial mark is simple, not flexuous.

2987.—The Transverse Ungulina

(*Ungulina transversa*). M. Deshayes, in his remarks on the present genus, considers it to be nearly allied to Lucina, and states that the ligament of the hinge is not internal, but really external; and, moreover, that the two species described by Lamarck are mere varieties of one.

The Transverse Ungulina is stated in the last edition of Lamarck to be a native of the seas of Senegal; and we learn that Mr. G. B. Sowerby has received specimens from Senegal, and has good reason to believe the shells to be marine.

From observations recently made by M. Rang, there is reason to believe the ungulina to be rock-boring in its habits. This is inferred from certain fossil shells belonging to the genus found in the environs of Bordeaux.

The right hand figure below represents the characters of the hinge enlarged.

We now come to the genus Saxicava.

This genus is placed by M. de Blainville and M. Rang among the Myadæ (the Pylorideans of the former), and they are very probably correct in their views. M. de Blainville indeed observes that Saxicava differs but little from Glycimeris, Lam.

Mr. G. B. Sowerby, who adopts the genus Saxicava, refers to it various shells, which, in conformity with the views of different naturalists, have been placed in six separate genera, nor has he done this without the most patient and rigorous scrutiny.

In the first place, he says, it is beyond dispute, that the Solen minutus of Chemnitz and Montagu, the Hiatella arctica of Daudin, the Cardita arctica of Bruguière, and the Byssomya of Cuvier are one and the same species; and secondly, the Pholeobius of Leach includes, as distinct species of the same genus, the Solen minutus of Montagu and the Mytilus rugosus of Linnæus.

Here then are six generic titles, Solen, Hiatella, Cardita, Byssomya, Pholeobius, and Mytilus, under which have been described shells which he regards as Saxicavæ.

Now, says Mr. Sowerby, the Solen minutus of Montagu "is the Hiatella arctica of Lamarck and Turton, and the Mytilus rugosus, Linn., is the Saxicava rugosa of the same authors. Thus all the six genera are reduced to one by Dr. Leach, whose authority is indisputably very great in such matters. We do not however (continues Mr. Sowerby) propose to our readers to take it as conclusive, but will state that we possess, as Dr. Leach did, a series of specimens, the young ones of which are more regular in shape and more strongly spinous than the older, and are to all intents and purposes Hiatella arctica or Solen minutus; while the older specimens, losing the strongly marked double row of spines, though always retaining indications of them, and assuming a much less regular form, become characteristic specimens of Saxicava rugosa. The hinge-teeth of the younger specimens may be advanced as an argument against the identity of these shells; it is however well known that in many shells, particularly those that are irregular, the teeth become obsolete with age; and thus if the hinge-teeth, the general form of the shells, or the double row of spines cannot be depended upon as generic distinctions, the Lamarckian genera Hiatella and Saxicava, and Lamarck's Solen minutus, merge into one." "It is," he adds, "sufficient to observe, that in all irregular shells which are found either attached to or imbedded in rocks, corals, roots of sea-weeds, &c., the general form cannot be taken as a character, and we believe the Mytilus præcisus, and several of the Saxicavæ described by Lamarck and Turton, to be mere variations of Saxicava rugosa, than which there is no shell, perhaps, more subject to variety of form." ('Genera,' No. xxv.) Mr. Sowerby illustrates his views by the figures of Saxicava rugosa in different stages of existence.

2988.—The Rugose Saxicava

(*Saxicava rugosa*). A, the young shell, with its double row of spines; B, the inside of the valves, showing the teeth; C, C, full-grown specimens, showing the difference in the figure of the valves; D, the inside of the valves, showing the muscular impressions.

The views of M. Deshayes coincide very nearly with those of Mr. G. B. Sowerby. When, says M. Deshayes, "we examine the shells of Byssomya, and compare them with those of Saxicava, we find no difference between them; whilst in the animals a much greater discrepancy exists, because the Byssomyæ perforate, and carry behind a rudimentary foot a byssus, like that of the Mytili. The mantle is closed for a good part of its length, and is prolonged backwards into two siphons, joined together to the summit. If we appreciate these differences at their just value, we may easily perceive that they are not of such great importance as they may appear to be, for a byssus affords the means of living on one and the same spot, no less than it secures the faculty of penetrating stones; we must therefore consider the character of the byssus in the Byssomyæ as of little value, for the greater number of zoologists have united this genus to the Saxicavæ." With respect to Solen minutus and Hiatella arctica, he adds, they are the same; and that the species belongs to the byssiferous Saxicavæ, as he has proved by an examination of the animal.

M. Rang thus details the generic characters of Saxicava, as presented by S. rugosa:—

The shell is thick, solid, and covered with an epidermis; it is of an elongated form, rounded in front, more or less truncated posteriorly, gaping, and irregular. The umbones are not very distinct; the hinge is without teeth, or presents two separated tuberosities more or less developed; the ligament is external. The muscular impressions are rounded, and united by a small straight pallial mark, which is very narrow, and runs along the middle of the valve.

The mollusk has the mantle closed, with an anterior orifice for the passage of an elongated delicate pointed foot, and with two posterior siphons united together, forming a double tube.

The range of the Saxicavæ is very extensive; they are found in the Northern Ocean, the British seas, the Mediterranean, the seas along the warmer parts of America, the South seas, &c. Some are found in the interstices between agglutinated oysters, and in the fissures of rocks or corals: others bore under the roots of sea-weeds, or perforate chalk, limestone, and hardened clay; and Mr. Sowerby states that those which themselves perforate the hollows in which they live have a more regular form than the others.

The species of this genus, as may be supposed from the variations to which they are subject (and which have already led to no little confusion), are not easily to be distinguished from each other.

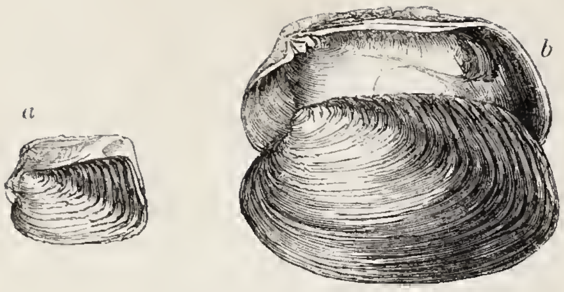
The species however are not numerous; M. Deshayes gives the number of recent species as five, to which must be added three described by Mr. G. B. Sowerby in the 'Proceeds. Zool. Soc.' 1834, p. 88. They were collected by Mr. Cuming, and were respectively found in masses of coral, in sandy mud, and the clefts of rocks. About twelve fossil species are known.

2989.—The Northern Saxicava

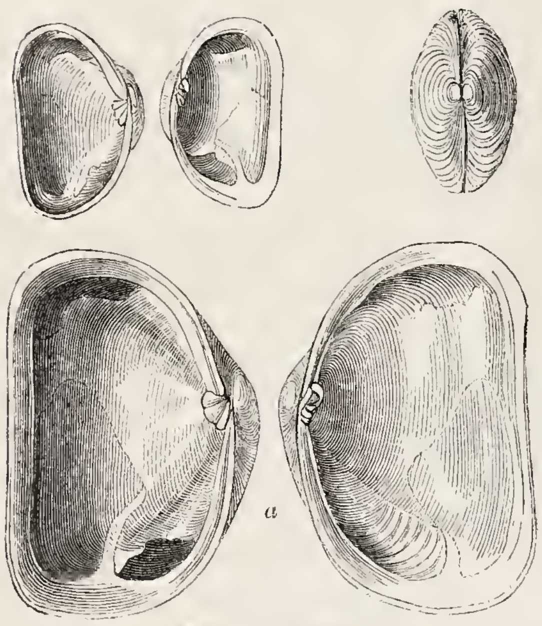
(*Saxicava Pholadis*). Mytilus Pholadis, Müll.; Mya byssifera, Fabr.; Byssomya Pholadis, Cuv.

As we have already said, Mr. G. B. Sowerby refers Cuvier's Byssomya to Saxicava.

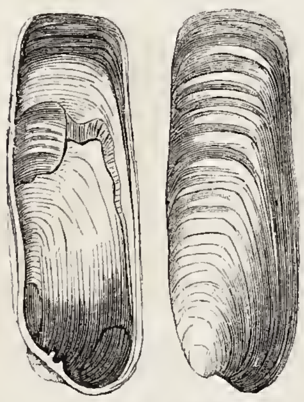
This species (if it be distinct from S. rugosa) inhabits the northern seas, living in the fissures of rocks, and attached by its byssus; sometimes however it lodges in stones, or buries itself in the sandy mud, at the roots of sea-weeds; in the latter instances, according to Fabricius, the byssus becomes lost.



2978.—Boring Rock Venus.

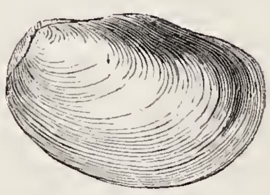


2986.—Faujas's Clotho.

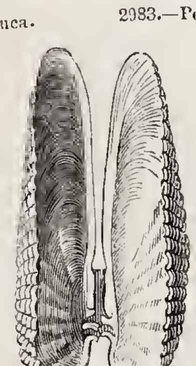


2985.—Cardite Coralliophaga.

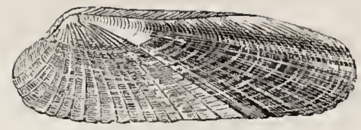
2982.—Petricola ochroleuca.



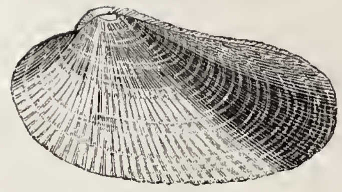
2983.—Petricola rupestris.



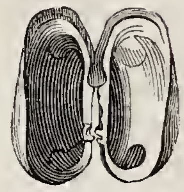
2979.—Petricola pholadiformis



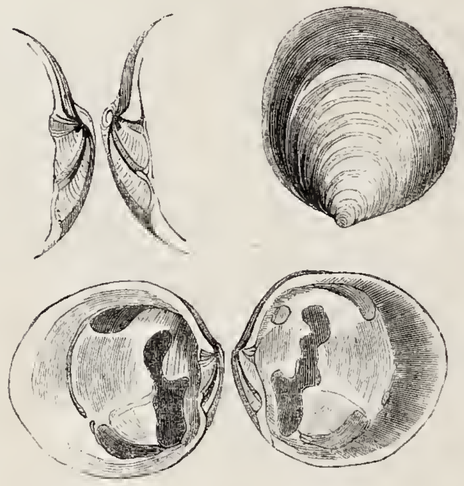
2980.—Petricola pholadiformis.



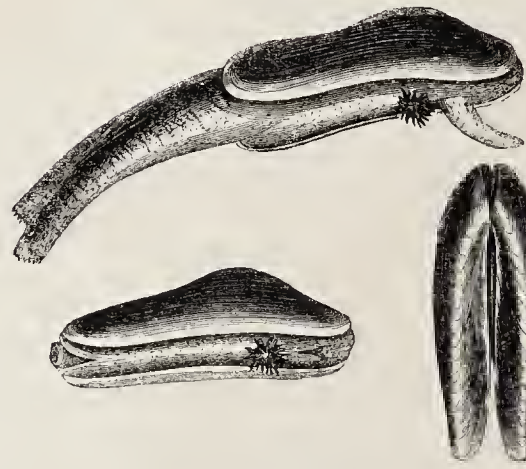
2981.—Petricola dactylus.



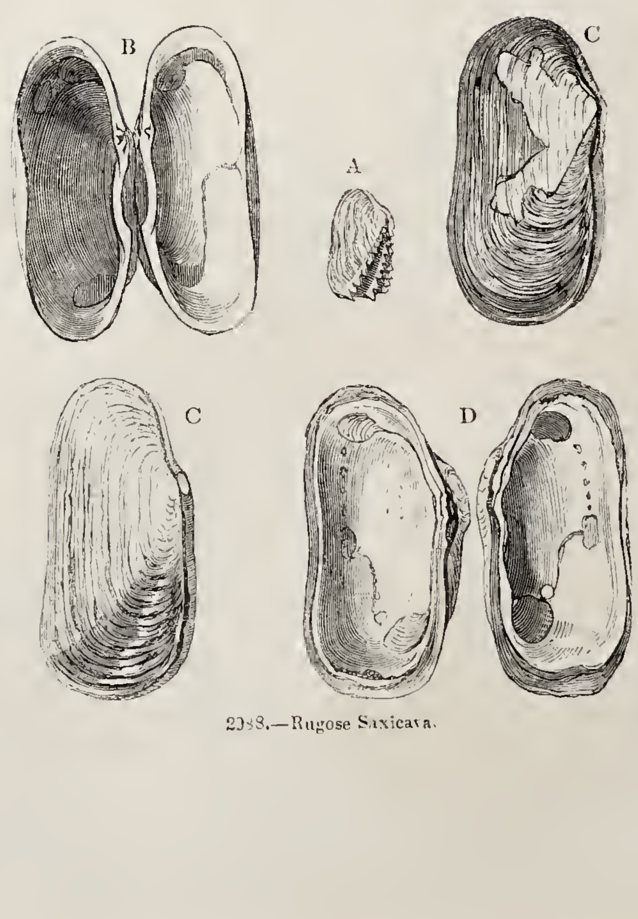
2984.—Petricola subglobosa.



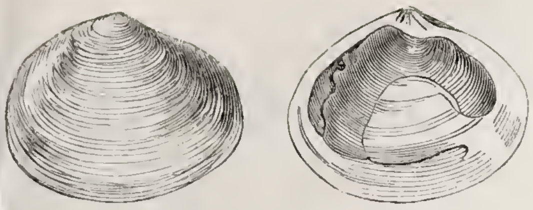
2987.—Transverse Ungulina.



2989.—Northern Saxicava.

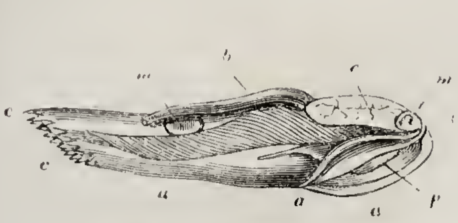


2988.—Rugose Saxicava.

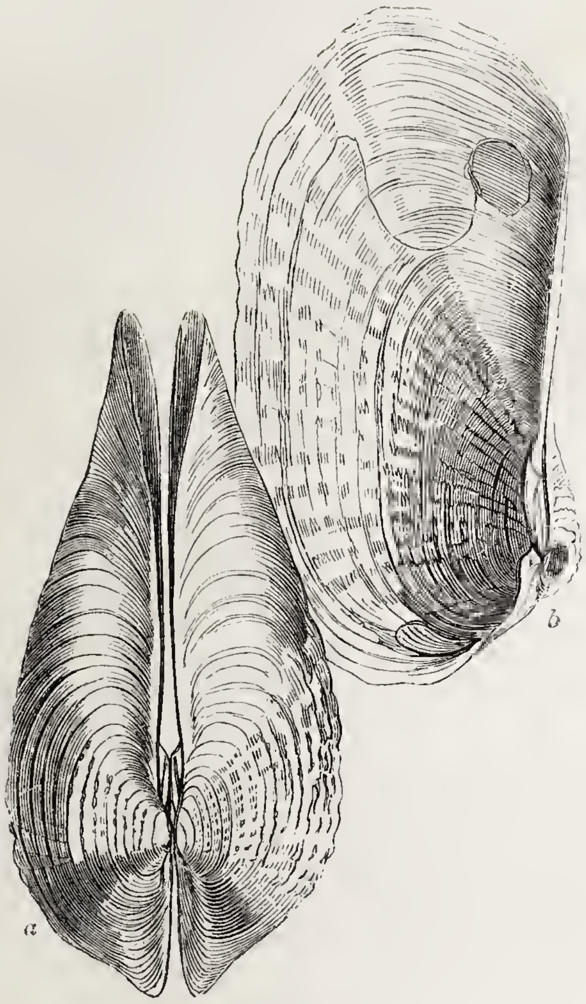


2994.—Compressed Lutricola.

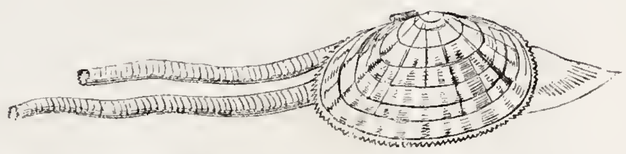
2990.—Shell of Beaked Pandora



2991.—Mollusk of Beaked Pandora



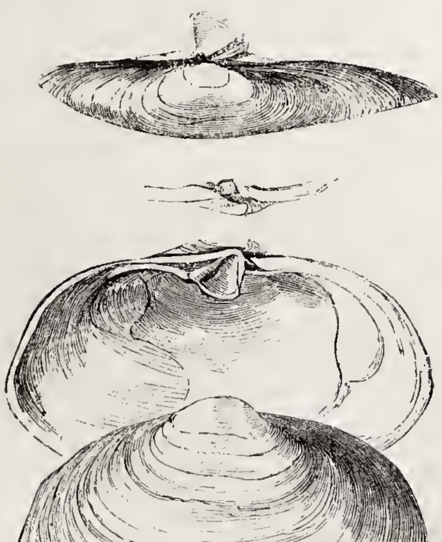
2996. White Pholadomya.



2998.—Mediterranean Sanguinolaria

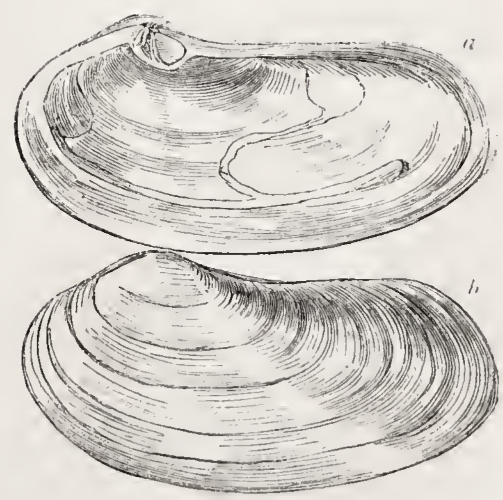
2999.—Roseate Sanguinolaria.

2997.—Radiated Soletellina.



2993.—Common Mya.

2992.—Subrostrate Anatina.



2995.—Solen like Lutraria.

We now come to a great section of the Conchifera, called by Cuvier Les Enfermés, which he thus characterizes :—The species have all the mantle open at its anterior part, or towards its middle only, for the passage of the foot; while posteriorly it prolongs itself into a double tube protruded from the shell, which is always gaping at its extremities. Almost all the species live buried in the sand, in mud, in stones, or in wood. This group contains two families of M. de Blainville, viz., the Pyloridians and the Adesmacians. To the latter are assigned the Pholades, the Teredo, and Fistulana; to the former, all the other genera.

We have already said that M. de Blainville places the Saxicavæ among the Pyloridians, and we are inclined to think this their true situation. It is among the Enfermés that Cuvier places his Byssomya.

Family MYADÆ (MYA, PANDORA, &c.).

The Myadæ or Myidæ are described by Lamarck as slender-footed Conchifera; the mantle having its lobes not united or scarcely united anteriorly: the gaping of the shell is often considerable. The ligament is internal.

The first genus to be noticed is Pandora. In this genus the shell is delicate, regular, elongated, and compressed; the valves are unequal, the right being flattened, the opposite more or less convex. The umbones are depressed; the hinge presents a cardinal tooth on the right valve, corresponding with a cavity in the left. The ligament is internal, oblique, and triangular; and is inserted into a little pit with rather projecting edges. Muscular impressions rounded, that of the mantle but little apparent. The mollusk is oval, and rather elongated; the two tubes of the mantle are united only at their base. The foot is large, triangular, and swollen at its extremity. Labial appendages rather large.

The species of Pandora are widely spread; they are found in the seas of Northern Europe, in the Mediterranean, the Pacific, on the coasts of North America, of New Zealand, and the Philippine Islands. They live buried deep in the sand, and are not to be captured without some trouble.

2990.—THE BEAKED PANDORA

(*Pandora rostrata*). This species is a native of the coasts of England and the adjacent continent. *a* shows the interior of the deep valve; *b*, the interior of the flat valve; *c*, the shell with the valves closed.

Fig. 2991 shows the mollusk of Pandora rostrata; *a*, *a*, *a*, *r*, the mantle opened anteriorly to show the foot; *p*, the foot; *b*, portion of intestinal canal; *e*, the liver covered by the eggsac; *m*, *m*, the adductor muscles; *c*, *c*, the siphons.

We may now pass to Anatina. In Anatina the shell is delicate, oval, elongated, and gaping at one or both extremities; the hinge is destitute of teeth, but is furnished with a horizontal, excavated, or spoon-shaped process, receiving the internal ligament, and sustained by an oblique lamina passing into the interior of the shell. Pallial impression very trifling.

The Anatinæ occur on sandy shores and in shallow water. Two species are described by Mr. Sowerby in the 'Zool. Proceeds.' 1834, brought home by Mr. Cuming, one from New South Shetland, the other from St. Elena; other species have been obtained from the Philippine Islands, &c.

2992.—THE SUBROSTRATE ANATINA

(*Anatina subrostrata*). This species is found on the shores of New Holland. Its shell is very delicate and membranaceous; the anterior extremity is attenuated; the gape wide.

From this genus we turn to Mya: the shell is invested with an epidermis, prolonged upon the mantle and siphons of the mollusk; it is rather solid, gaping at both extremities, and equivalve. The hinge is composed of two oblique folds diverging backwards from a horizontal spoon-shaped process on the left valve, and corresponding to an equally horizontal pit in the right valve; the ligament is internal, inserting itself between the pit and the spoon-shaped process. The anterior muscular impression is elongated, the posterior rounded; the pallial mark is narrow and deeply furrowed.

The Myæ are burrowing in their habits, and live buried in the sand of flat beaches, or in the alluvial deposit of æstuaries, with the siphons just projecting above the surface. Some species are European.

2993.—THE COMMON MYA

(*Mya arenaria*). This example of the genus is found on the shores of our own island and those of the adjacent continent, where beds of sand in shallow water afford a suitable locality. Our pictorial specimens exhibit the structure of the hinge and the marks on the inside of the valves. A few fossil species of this genus are recorded, and M. arenaria and truncata are found in a fossil state, as well as living.

Closely related to Mya is the genus Lutricola of M. de Blainville. He describes the shell as being oval or elongated, and equivalve; the hinge presents two very small cardinal teeth, sometimes effaced, before a large triangular pit; the ligament is double, the external portion is posterior, and not extensive; the internal portion is thicker, and inserted in the fossets. The muscular impressions are distinct, and united by a pallial mark, which is sinuous posteriorly.

The mollusk is furnished with long siphons, and a small and scarcely projecting foot.

2994.—THE COMPRESSED LUTRICOLA

(*Lutricola compressa*). We select as an example this species, which is a native of the European seas, and occurs in the British Channel. The shell is thin, compressed, rounded, and transversely striated; the colour is dirty grey, with a tinge of yellow or reddish.

A section or subgenus of Lutricola is termed by Lamarck Lutraria. The shell is oblong, subcylindrical, and widely gaping. The hinge-teeth are two, and strong; and the spoon-shaped process of the ligament is vertical.

2995.—THE SOLEN-LIKE LUTRARIA

(*Lutraria solenoïdes*). Mya oblonga, Gmel.; Mactra hians, Dilw.

The Lutrariæ and the Lutricolæ frequent sandy beaches, in which they bury themselves, and thus avoid their enemies. The present species is found in the seas of Europe: the shell is marked with transverse rugose striæ; the colour is dirty white, or reddish.

It is here, perhaps, that we may introduce that interesting form for the knowledge of which we are indebted to Mr. G. B. Sowerby, and to which he gave the generic title of Pholadomya. His description was taken from a recent species brought from the island of Tortola, which passed into the possession of Mr. Broderip, and (with that zoologist's noble collection) is now in the British Museum.

The generic characters are thus detailed :—Shell very thin, rather hyaline, transverse, ventricose; inside pearly; anterior extremity short and rounded, the posterior more or less elongated and gaping. Hinge with a small and elongated pit, of a triangular form, and a marginal lamina in each valve, to the outer part of which is attached the short ligament, which is external. Muscular and pallial impressions indistinct.

A description of the mollusk, by Professor Owen, was communicated to Mr. Broderip. Pholadomya, he observes, "presents all the family characters of the Inclusa, or Enfermés, but differs generically from all those the organization of which has hitherto been described, by the presence of a fourth aperture leading to the interior of the mantle; that is to say, besides the linear slit for the protrusion of the narrow foot, at the anterior part of the ventral aspect of the mantle, and the two siphonic tubular passages, there is at the under or ventral part of the united siphons a small round aperture, which is continued upon a truncated pyramidal papilla projecting itself into the pallial cavity, forming a valvular obstruction to the exit of fluids, but admitting their entry. This doubtless relates to some curious and peculiar feature in the economy of the mollusk."

The discovery of this recent species, observes Mr. Sowerby, has led to the more perfect knowledge of several fossils, the genus of which was before exceedingly doubtful; and which were in fact referred by authors to several genera, to none of which they really belonged. Of these, some have been assigned to the genus Cardita, and others to Lutraria. They occur in several rocks of the oolitic series, particularly the cornbrash, the inferior oolite, and fuller's-earth, as well as in the lias, in the London clay, the Sutherland coal-field, and the dark-coloured clay at Alum Bay.

2996.—THE WHITE PHOLADOMYA

(*Pholadomya candida*). The Pholadomya is most probably an inhabitant of deep water; the specimen on which Mr. G. B. Sowerby characterized the genus was thrown upon the beach of Tortola after a violent storm. The shell is marked with decussate striæ, which are decurrent from the umbo. *a* represents the shell with the valves shut, the umbones anteriorly; *b*, the inside view of one of the valves, showing the impressions of the muscles and mantle, and the umbo worn by the repeated opening of the valves; the wear to which they were naturally more exposed than the other parts.

Family SOLENIDÆ (SOLENS, or RAZOR-SHELLS, &c.).

In the Solenidæ the ligament is external and convex. Our first pictorial example belongs to the genus Soletellina, the shell of which is oval and compressed, with sharp edges; the umbones are but little elevated; the hinge presents one or two very small cardinal teeth; the ligament is thick and convex; the pallial impression is very sinuous backwards.

The animal is not known.

2997.—THE RADIATED SOLETELLINA

(*Soletellina radiata*). This species is a native of the Indian Seas; the shell is of a violet tint, with obscure rays.

The genus Soletellina differs very little from Psammocola, and to this the genera Psammobia and Sanguinolaria are intimately allied.

The genus Sanguinolaria has an oval shell, much compressed and scarcely gaping; the hinge presenting one or two cardinal teeth in each valve, and a projecting convex ligament. The pallial impression is sinuous backwards. Cuvier says that in Sanguinolaria there are two teeth in each valve, and in Psammobia and Psammothea only one. The distinctions between these genera are in fact very superficial and indeterminate.

2998.—THE MEDITERRANEAN SANGUINOLARIA

(*Sanguinolaria occidens*). Psammobia occidens, Desh.—This species is a native of the Mediterranean: the shell is variegated with white and red, and radiated. The mollusk is remarkable for the length of its two siphons.

2999.—THE ROSEATE SANGUINOLARIA

(*Sanguinolaria rosea*). Psammobia rosea, Desh.—This species is a native of the West Indian Seas: the cardinal teeth in each valve are two; the valves are regular and pretty well closed; their colour is white with roseated umbones.

Several new species of Sanguinolaria and Soletellina have been collected by Mr. Cuming at the Philippine Islands.

These mollusks are found buried in sands and sandy mud, at depths varying from a few fathoms to twelve or fourteen.

Another genus to be noticed, is that termed Solecurtus. The shell is oval-oblong, covered with undulating oblique and longitudinal striæ; both extremities are gaping. There are two cardinal teeth in one valve; one, rarely two, in the other. The ligament is external and convex; the pallial impression deeply sinuous.

The mollusk is too large for the shell; the lobes of the mantle are thick, and prolonged into two great unequal siphons, united near their summit. The foot is tongue-shaped, large, and thick; the labial palps are long and narrow.

3000.—THE STRIGILATE SOLECURTUS

(*Solecurtus strigilatus*). Solen strigilatus, Lam.—This species occurs in the Mediterranean, and, according to Lamarck, also in the Indian Ocean. The shell is very convex, and sculptured with oblique striæ. The general colour is roseate, with two rays of white.

We now pass to the genus Solen, containing the Razor-shells, as they are commonly termed, which may be known by their elongated figure, the valves gaping and truncated at both extremities, and with nearly parallel edges. The shell is generally delicate and translucid, and covered with an epidermis; the umbones are completely anterior; the hinge presents one or two teeth; in the specimen before us two teeth in the left and one in the right valve; the ligament is convex, elongated, and fixed in a marginal fissure. The muscular impressions are distant, the pallial mark straight.

As may be inferred from the shell, the animal is elongated, and has the mantle closed to a great extent, adhering by its borders, and bound to the edge of the shell so as to form the epidermis; it is produced backwards into a double siphon, the tubes being united together, conical, and capable of much elongation. From the anterior part, where the mantle is open, in accordance with the gape of the shell, a long and powerful foot protrudes, which serves as an instrument for boring into the sand. The branchiæ are highly vascular, long, and narrow.

Fig. 3001 exhibits the animal and open shell of Solen Vagina: the foot and double siphon are seen retracted; the anterior part of the mantle is open for the freedom of the foot.

Fig. 3002 represents the shell and animal of Solen Legumen. The tubes of the siphon are seen separated; and the foot is protruded from the anterior apex.

Fig. 3003 shows the valves of Solen Ensis. *a*, an external view with the valves closed; *b*, an internal view of one of the valves.

Several species of Solen are natives of our shores and those of the Continent; as for example, the three species to which we have alluded. These

mollusks live on extensive sandy beaches, or at the mouths of rivers where a deep bed of silt affords them the facility of burrowing; they bury themselves in a vertical position, with the foot downwards and the siphons upwards, the apertures of the latter just projecting above the surface of the bed. Here they quietly remain, taking in food and water through the larger siphonic tube as the tide flows over them; when disturbed, down they plunge into the oozy sand, disappearing with astonishing celerity, often baffling the most active endeavours to capture them, and making their way to the depth of several feet. When the danger is past, they gradually re-ascend, by the extension and contraction of the powerful foot, but are ready in an instant to disappear. The whole of their active existence is thus passed in descending to the depths of their burrows and in reascending to the surface.

The foot is cylindrical, but alters its shape according to need in the process of burrowing.

The inhabitants of the coasts on which the Solens are found, search for them, sometimes as food for the poorest of the community, but generally as baits for catching fish. The most favourable time for taking them, is after high tides; they then often appear just emerging from their burrows in great numbers. The ordinary plan is to throw into their burrows as they withdraw themselves a small quantity of salt, which so irritates the animals that they immediately ascend out of their holes, in order to get rid of it. They are then seized, but some address is required lest the animal should re-enter as rapidly as it came forth. Another plan of taking these shell-fish is by means of a long iron hook, which the fisherman plunges deeply into the sand, and drawing it out obliquely with a jerk, carries away sand and solen also.

Family PHOLADÆ (PHOLAS, &c.).

The family Pholadæ comprises a group of mollusks, the boring habits of which have been long known; they penetrate wood, hard clay, chalk, and rocks, and devastate the labours of man; they attack the hulls of ships, submarine piles, the foundations of piers and breakwaters, and consequently become objects of anxious interest: they force themselves upon our attention by their insidious but extensive depredations, the results of which not only involve the loss of property, but often also of life.

The first genus to which we shall direct attention is that termed Pholas, including its subgenera, Xylophaga, Pholidæa, &c.

In the genus Pholas the shell is delicate, white, rather transparent, sometimes covered with a thin epidermis, of an oval elongated figure, and gaping at both extremities; the umbones are hidden by a callosity; the hinge is toothless and without a true ligament; a flat recurved spoon-shaped process, enlarged at its extremity, elevates itself within each valve below the umbo. The muscular impressions are very distant, the posterior one is large and distinct, the anterior small, and often scarcely apparent; the pallial mark is deeply furrowed posteriorly. To the shell thus characterized are often added certain accessory pieces; sometimes a calcareous tube envelops all the parts, leaving an aperture posteriorly.

The mollusk, thus protected, is generally elongated, with the mantle reflected on the dorsal part, for the purpose of tying together the valves and the accessory pieces. The foot is short, oblong, and flattened. The siphons are elongated and united into a single very extensible and dilatable tube. The mouth is small, with trifling labial appendages. The branchiæ are elongated and narrow, and prolonged into the inferior siphon.

The number and disposition of the accessory pieces in the shell of Pholas vary considerably; and it would appear that the animal, as it bores its way, sometimes deposits a calcareous tubular lining on the internal wall of the cavity it inhabits. M. Rang states that this fact he has not been able to verify from living species, but that M. des Moulins showed him several fossils from Mérignac, in which he completely recognised this important character.

A more clear idea of the forms of the animal and shell of Pholas will be conceived by referring to our pictorial specimens.

Fig. 3004 represents the animal and shell of Pholas Dactylus; the lower or ventral part is presented to the spectator, showing the gape of the valves. *a* is the mantle, open anteriorly for the protrusion of the foot; *b*, the foot; *c*, the double siphon, emerging from the posterior aperture of the shell, *d d*.

Fig. 3005 represents another species of Pholas (Ph. clavatus?), seen at a side view: *a*, the siphon; *b*, the mantle; *c*, the foot.

Fig. 3006 represents the shell of Pholas Dactylus, with its accessory valves visible. A, the accessory valves: *a*, the anterior pair; *b*, the central piece; *c*, the posterior piece. B is an exterior lateral view of the shell, with the accessory valves in situ. C is an internal view of one of the valves: *a*, the internal spoon-shaped process, under the umbo.

Mr. Sowerby, in reference to Pholas, says, "We believe that all the shells of this genus are furnished with a greater or less number of accessory valves, which appear to be caused by the deposition of shelly matter (within the epidermis and connected with the valves by that membrane), wherever such valves were necessary for the security of the inmate.

They are consequently very various in form, and placed in different situations in the different species, though in most cases they are placed near the hinge, and have ever been considered to be substitutes, in these shells, for the permanent ligament of other bivalves. We must for the present withhold our assent from this opinion, because, on account of the situation in which they live, the animals inhabiting these shells can have very little occasion to open their valves: whether or not there is any permanent ligament in this genus, as we have never observed the animal alive, we cannot undertake to determine. Turton says it has none; Lamarck, on the contrary, speaks of the accessory valves covering and hiding the ligament. As far as we can form an opinion from dried specimens, we cannot consider the substance to which these valves are attached as the ligament, but as part of the adductor muscle; nevertheless we think we can in some species perceive a very small internal ligament, attached to two unequally-sized small curved teeth, one in each valve, placed in the same situation as the hinge-teeth of common bivalves." He adds, "The principal differences between Pholas and Teredo consist in the latter forming a shelly tube behind its valves, and in its being destitute of accessory valves; moreover the two valves of the latter, when closed, are nearly globular."

The same conchologist makes the following valuable remarks, in an introduction to the description of eleven new species brought by Mr. Cuming chiefly from the western parts of South America and the islands of the South Pacific Ocean:—"The utmost caution (he says) is necessary in the examination and description of the various sorts of Pholades, on account of the extraordinary difference in the form of the same species, in different stages of growth. The addition of accessory valves, also, as they increase in age, must be carefully observed, in order to guard against too implicit a confidence in their number and form. And though I might be considered guilty of asserting a truism by stating that the difference in size of different individuals of the same species may and sometimes does mislead the tyro in the science of Malacology, lest such difference should mislead the adept also, let him, too, proceed cautiously; and when he finds a full-grown shell of half an inch in length, agreeing perfectly in proportions and characters with another of two inches long, let him not conclude that it is a distinct species, but if he can find no other difference except that which exists in their dimensions, let him consider the one a giant, the other a dwarf. Let it be remembered that among the Cypræae it is not uncommon to observe young shells of three inches in length, and fully grown ones of the same sort only an inch in length. Likewise of the British Pholades there are individuals quite in a young state of two inches in length, and perfectly formed shells of the same species not more than half an inch long. For instance, in demonstration I need only refer to the Pholas papyraceus, so abundant at Torquay, of which the young shells have been considered by many as a distinct species, and have been named by Dr. Turton Ph. lamellosus. This varies in size exceedingly, so that it may be obtained both in an incomplete and young state, and in a fully grown condition, from half an inch to nearly two inches in length. The circumstance of its having rarely occurred in an intermediate state of growth, when the anterior opening is only partly closed and the accessory valves only partly formed, led Dr. Turton and others to persist in regarding the young and old as two distinct species."

M. Deshayes says that there is no true ligament in Pholas, but that a part of the anterior muscle is inserted on the cardinal callosities, and occupies the place of a ligament. In Teredo, also, there is no true ligament. With respect to the internal spoon-shaped processes, they are buried in the thickness of the animal, and embrace in their concavity a part of the liver, the heart, and intestines.

The genus Pholas is very widely distributed; and all the species manifest the same boring habits as those in our own and the adjacent coasts, and of the ravages of which the Breakwater at Plymouth affords proof. We have now before us a piece of hard chalk completely mined in all directions with pholades, and which we picked up near Ramsgate, where other masses of the same character were seen in abundance, and filled with the empty and dead shells of the borers. Some of Mr. Cuming's specimens were in soft stone, others in hard stones, others again in limestone, hard clay, decayed wood, and the trunks of trees at low water. With respect to the means by which these creatures effect their boring operations, many opinions have been entertained. Some have attributed the perforations to a rotatory motion of the shell, by which the stone or chalk is, as it were, rasped away. But as the shells fit the cavities in which they are lodged, this opinion has no support; besides, one would think that the extremely delicate valves of Pholas would themselves become worn down by such a process sooner than rock. Others, again, have attributed it to the action of currents of water produced by the vibratile cilia of the animal, and directed so as to act anteriorly to the animal, which presses onwards as the currents wear down the stone. It is possible to conceive that such currents may take an effect on soft materials of which the particles become readily disintegrated, but when we see solid blocks of timber, as oak, riddled in every direction, we cannot but hesitate as to the part which ciliary currents take in such perforations. The constituent particles of oak are, one would think, too adherent to yield to minute ciliary currents of water, the force of which must be very trifling. Others, again, have attributed the whole to the agency of some chemical solvent poured out by the mollusk. To say nothing of the danger to which its own shell would be exposed, this theory is discountenanced by the circumstance that the rocks or stones bored are of different natures, as limestone, clays, sandstones, &c., to say nothing of wood. Now we can scarcely suppose that the same chemical agent will dissolve one and all of these substances; unless, indeed, we are to suppose that each species bores only into one given material, a circumstance which we do not know there is any ground for supposing, though perhaps some, as the delicate Pholas conoïdes, may be oftener found in hard wood than in stone.

Mr. Sowerby, in his notice of the Pholas acuminata (loco supràdict.), found at Panana in argillaceous limestone, at low water, says, "This species demonstrates a fact of considerable importance to geologists. It is in argillaceous limestone, very much resembling lias, and in forming the cavity in which it resides it has, by such a chemical process as frequently takes place, absorbed a much greater quantity of the rock than could be retained or converted. This is again deposited at the upper part of the cavity, and thus the rock is recomposed." We think this fact equally as valuable to the zoologist as to the geologist. It seems to indicate that it is by absorption that the tunnel is bored. May not the broad foot, we would ask, be a powerful organ of absorption, and be in constant application, like a sucker to the end of the tunnel, throwing into the system the matter taken up, and which is again thrown out through the upper of the two siphons; or, as in the instance of Pholas acuminata, re-deposited at the upper part of the cavity, so as to recompose the rock as the mollusk pushes onwards. And further, may not the tube-lining the internal wall of the cavity, as observed by M. des Moulins in the instance of the fossil Pholades from Mérignac, have been produced by the excreted materials previously absorbed? According to this view, the foot would serve a double purpose: adherent to the extremity of the tunnel, it would carry on the excavations by absorption, and draw the animal forwards, in accordance with the rapidity of the process.

Let it not be supposed that we wish to be positive on a subject which, after all, is involved in much obscurity.

A better idea that mere words will convey of the destructive labours of the Pholas, may be conceived by reference to our pictorial specimens.

Fig. 3007 represents the Pholas striatus in wood: the mass is completely riddled by the animals, to the shape of which it will be seen the cavities are precisely fitted.

Fig. 3008 shows a block of stone perforated by the Pholas Dactylus.

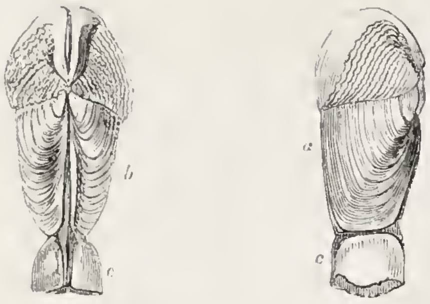
Fig. 3009 is a block of wood perforated by Pholas dorsalis (Xylophaga dorsalis).

Fig. 3010 represents the shell of Pholas dorsalis, the type of the subgenus Xylophaga. *a*, an enlarged view of the interior of the valves; *b*, a dorsal view, natural size; *c*, a ventral view, natural size.

Fig. 3011 represents the Pholas papyraceus, common on the coast of Devonshire, belonging to the genus or subgenus Pholidæa of Leach. The shell, with the animal inclosed, is seen in a side view at *a*; in a dorsal view at *b*; *c*, a terminal cup-shaped membrane.

The fossil species of Pholas are rare; they occur in strata below the chalk, and also in tertiary formations.

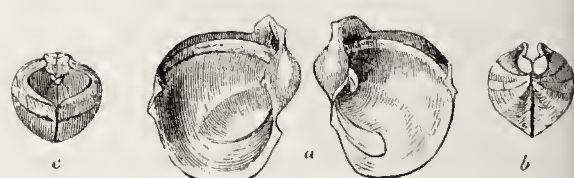
Within the limits of the Family Pholadæ we place the genera Teredina and Teredo, part of the Tubulidæ of Lamarck.



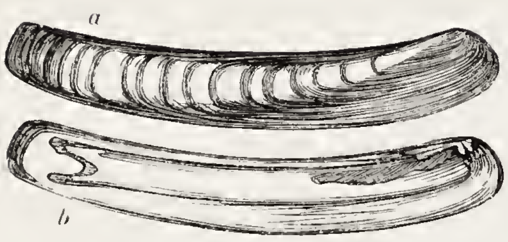
3011.—Pholas papyraceus

3008.—Pholas dactylus, in stone.

3001.—Solen Vagina.



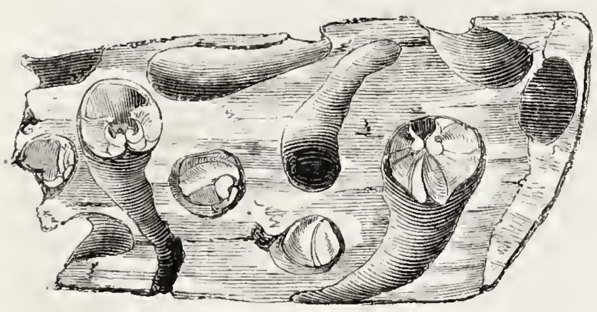
3010.— holas dorsalis.



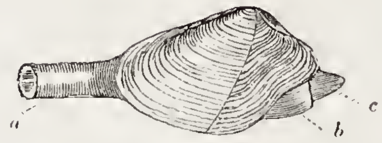
3003 —Solen Ensis.

3002.—Solen Legumen.

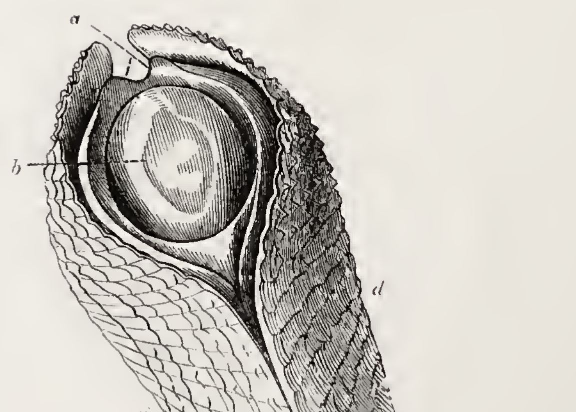
3007.—Pholas striatus, in wood.



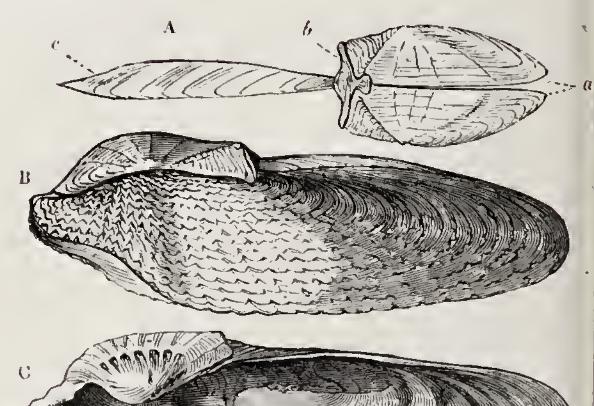
3009.—Pholas dorsalis, in wood.



3005.—Pholas clavatus ?

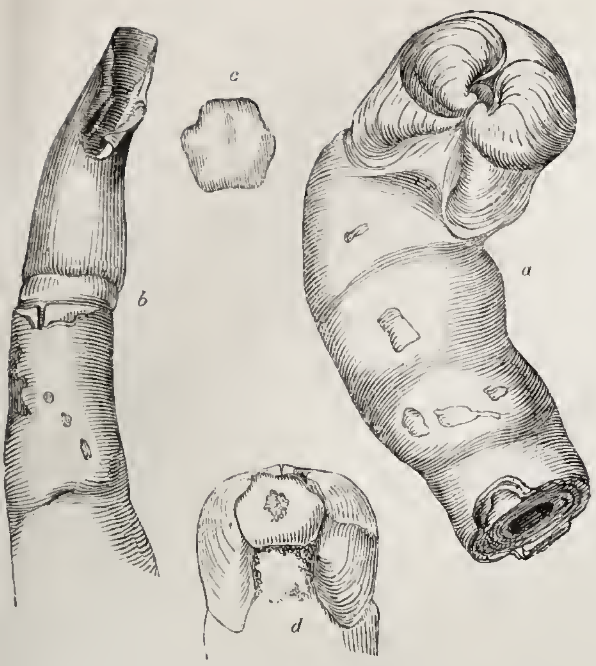


3004.—Pholas dactylus.

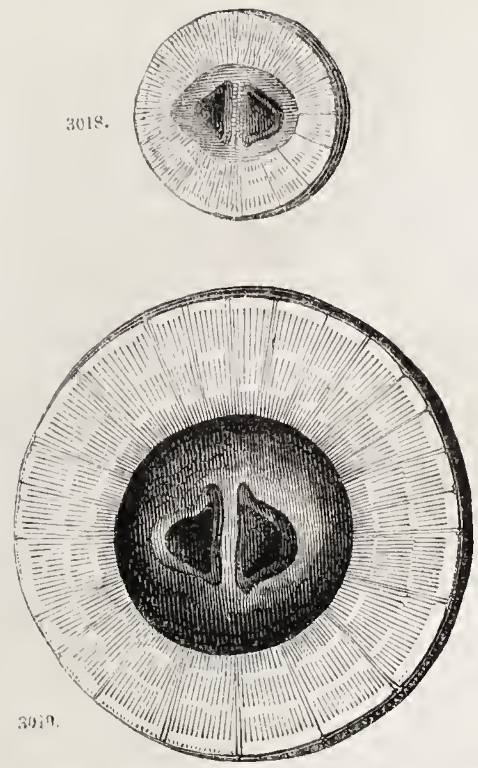


3006.—Pholas dactylus.

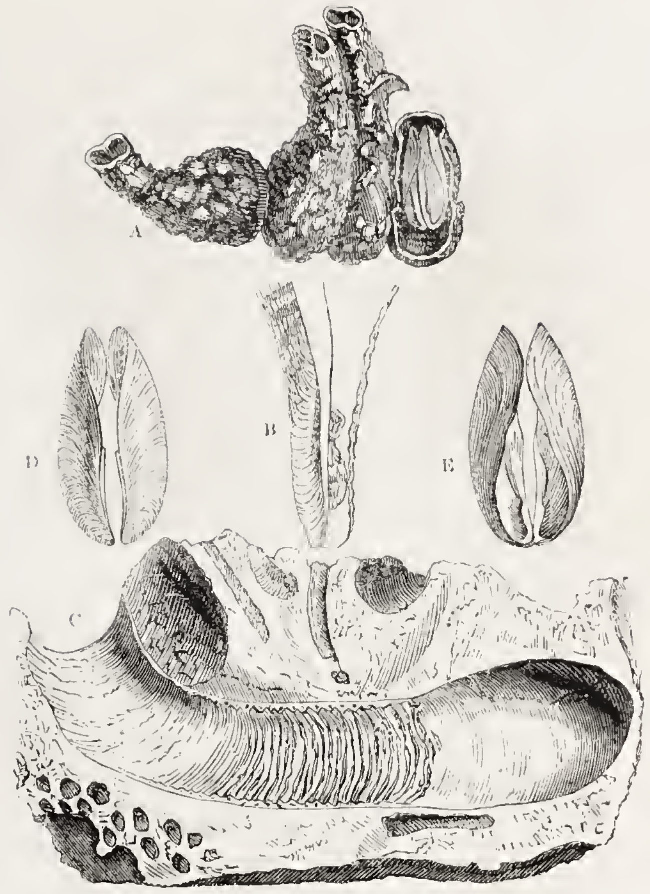
3000.—Strigilate Soleeurtus.



3012.—Masked Teredina.

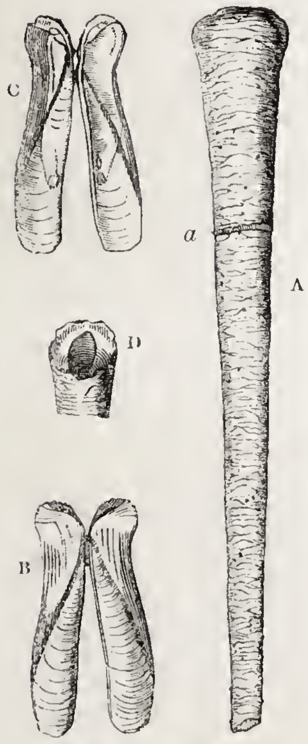


3018, 3019.—Transverse Sections of Shell of Teredo gigantea

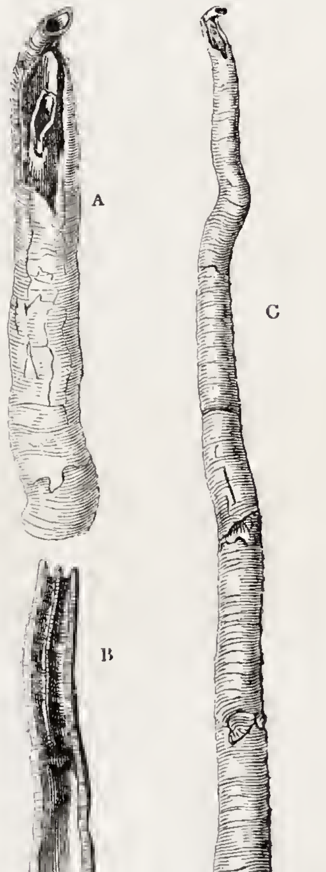


3020.—Gastrochæna.

3016.—Teredo gigantea. (From Rumphius.)



3021.—Fistulana clava.



3017.—Teredo gigantea. (From Griffiths.)

3014.—Shell and Tube of Teredo navalis.

3013.—Teredo navalis, out of shell.

3015.—Wood perforated by Teredo navalis.

3012.—THE MASKED TEREDINA

(*Teredina personata*). The genus Teredina is known only in a fossil state. Like Teredo, and other forms to which we shall presently allude, besides valves, it presents a tubular extension, solid, testaceous, and of considerable thickness, gradually diminishing as it proceeds; it is not divided by a partition into two siphons, but it is continued from and unites the posterior part of the two valves.

M. Deshayes remarks that Teredina is a true Pholas, with globular valves fixed at the end of a tube, and is furnished within with those appendages characteristic of Pholas and Teredo. Turning to the figure, *a* shows the valves with the basal part of the tube; *b* is the continuation of the same tube; *c*, an accessory valve; *d*, the two valves with the accessory valve in its place.

The Teredina personata is found in the Eocene beds of the tertiary system.

The genus Teredo is represented by that formidable animal Calamitas navium, the ravages of which upon submerged wood are so extensive and dangerous.

These animals, says Cuvier, Les Tarets of the French, have the mantle continued into a tube, very much longer than their two little rhomboidal valves, and terminated by two short siphons; a muscular ring at the point of junction of the mantle and the tubes has implanted there a pair of pediculated corneo-calcareous appendages, or "palettes," playing laterally one against the other. These mollusks penetrate when young into the interior of submerged wood, as stakes or piles, and the keel of ships, and, establishing themselves there, commit great mischief, riddling every part. It is supposed that the Teredo, in order to bury itself according to its growth, perforates the wood by the aid of its valves. The tubes remain always towards the orifice by which it made its entrance, and through which it draws in the water and nutriment, by the action of the "palettes." The tunnel in which it dwells is lined with a calcareous crust transuded from it, and which forms a sort of tubular shell.

The animal, we may add, is vermiform in shape, with a delicate mantle open in front, and at its lower part for the passage of a mammiliform foot; the mouth is small, with short labial appendages.

The shell is thick, short, annular, and open before and behind. There is no hinge; an elongated nearly straight spoon-shaped process presents a slightly marked muscular impression.

The tube is cylindrical, straight or flexuous, and becomes closed with age at the anterior extremity, so as to envelop both animal and shell, but it always remains open at the other end, and lines the cavity which the animal has perforated.

Sir Everard Home, whose account of the Teredo navalis, and a species called by him Teredo gigantea, were published in the 'Philosophical Transactions,' 1806, states, that on examining the shell of Teredo navalis while in the wood, he found the external orifice of the canal very small, and in fact only just large enough to give passage to the two small tubes or siphons. The canal at its termination and for an inch in length was not lined with shell, but smeared over with a dirty green-coloured mucus, which was also spread upon the last-formed portion of the shell. When the animal was alive, and undisturbed, what is termed the head was in contact with the end of the canal in the wood; but on laying bare the head it was drawn for an inch into the shell.

The largest of the worms (Teredines) examined measured eight inches in length; and many were alive twenty-four hours after being removed from the shell. The head of the worm was enclosed between the two boring-shells, and these were united together by a strong double muscle, having a middle tendon, and enclosing the œsophagus and other parts. On the opposite side of the head the shells were united by a ligament, and at this part were two small tooth-like processes, one from the narrow edge of each shell where they were joined together. From the middle of the exposed part of the head projected a kind of proboscis, which in the living animal had a vermicular motion; its extremity was covered by a cuticle not unlike the cornea of the eye; and it was found to cover a cavity like a Florence flask with the large end uppermost, and containing a hard brown-coloured gelatinous substance. This proboscis has no orifice, and Sir E. Home remarks, there is reason to believe it adheres to the wood, acting as a centre-bit, while the animal is at work with the shell, and thus the canal in the wood is perfectly cylindrical.

The mouth was nearly concealed by the projection of the proboscis, but was a distinct round orifice. The body of the worm was found enclosed in one general covering, extending from the base of the boring shell, with which it was connected, to the root of the two small tubes which appear out of the wood. It terminates in a small double fold, forming a cup, on the inside of which are fixed the stems of two opercula, which become broad and flat towards their extremity; these, when brought together, shut up the shell and enclose the two contracted limbs. The Teredo, he adds, turns round in the shell, to which the animal is not attached, and to which its covering has only a slight connexion at one particular spot, to prevent the external tubes from being disturbed. The motion, he observes, is for the purpose of boring.

Fig. 3013 represents the animal of Teredo navalis out of the shell. A. In this the opercula are wanting and the tubes retracted; B. In this specimen the opercula are in their situation: *a a*, the boring-shells; *b*, the proboscis; *c*, the mouth: *d d*, the contents of the abdomen, seen through the transparent external covering; *e e*, the branchiæ, seen in the same manner.

Fig. 3014 represents the tube and shell of Teredo navalis: *a*, the tube with the valves in their natural position at its anterior extremity; *b* and *c*, two views of valves; *d*, the two tubular siphons of the animal protruded.

Fig. 3015 represents a block of wood perforated by the Teredo navalis.

The Teredo navalis has been found at depths varying from the surface to ten fathoms; though unfortunately now so common in our seas, this terrible scourge is said to have been originally brought by ships from warmer climates. All submarine wood-work, such as the piles of piers, flood-gates, and the like, are soon riddled by it, often in spite of every precaution; and it has threatened the submersion of Holland by the destruction of the flood-gates and wood-work of the dykes.

The rapidity with which it commits its ravages is astonishing; a piece of deal after forty days' submersion has been found completely riddled by these animals, some of which had attained to a considerable size even in that short space of time. Montagu obtained a number of these animals in piles from the Dockyard at Plymouth, which were taken up to be replaced with new, although they had not been above four or five years under water, and were sound solid oak when driven. The most effectual way to preserve wood from the attacks of these "worms" is to cover the whole of the surface exposed to their depredations with short broad-headed nails, set as closely together as possible. The action of the salt-water on the iron produces a coating of rust, which is said to be superior in durability and effect to the copper sheathing with which the hulls of vessels are covered underneath.

It has been a question whether the Teredo navalis derives nutriment from the particles of the wood in which it drives its galleries, or the contrary. We think the probability is that it does not, and that the end of its boring is only to secure a proper habitation. It is, we believe, ascertained that an impalpable vegetable sawdust is found in the intestines, but unchanged by the process of digestion; and besides, at a certain period of existence the animal closes the tube and valves anteriorly, and ceases to bore, deriving its nutriment, through one of the open siphons, from the animal matters with which the sea-water is replete. Sir E. Home suggests that as the alimentary canal is straight and simple, the saw-dust may be needful in order to retard the progress of the food, that the complete digestion of the latter may be effected. This, however, is a mere theory.

A gigantic Teredo, Teredo gigantea, is found in the Indian Seas, but fortunately it does not bore into wood, its habitation being perforated in deep beds of hardened mud. This species, which attains the length of six feet, and perhaps much more, was first figured by Rumphius. His specimens were found in shallow water among mangrove-trees. In 1805 Captain Maxwell, of the Calcutta, East Indiaman, gave to Sir Everard (then Mr.) Home a specimen of this singular shell or tubular envelope, five feet long, though imperfect at both extremities. By some scientific men this was considered as a hollow stalactite, but Sir Joseph Banks regarded it as a shell, and chemical analysis confirmed the correctness of his opinion.

In the 'Phil. Trans.' for 1806 is a paper by Mr. Griffiths (to whom Sir E. Home was introduced by Mr. Marsden) on the Teredo gigantea, immediately preceding that by Sir E. Home.

Mr. Griffiths relates that a short time after a very violent earthquake which occurred in the year 1797, at Sumatra, and produced a most tremendous inundation of the sea, spreading desolation around and causing the loss of many lives, these shells were procured in a small bay with a muddy bottom, surrounded by coral reefs, on the island of Battoo. On the recession of the sea after the extraordinary inundation, they were observed protruding from a bank of slightly indurated mud, and two or three specimens were brought to Mr. Griffiths, by the master of a trading boat. Mr. Griffiths then sent one of his servants, a Papooa Coffree, who was an excellent diver, to procure others. This man stated that he had found the shells in the bay already mentioned, and also in an inlet of the sea, sticking out of hard mud mixed with sand and small stones; they protruded to the extent of eight or ten inches, and were from one to three fathoms under water.

Mr. Griffiths was assured that the animal throws out tentacula from the two apertures of the apex of the shell, resembling small Actiniæ (sea anemonies), and that the shell was filled with soft gelatinous flesh, similar to that of the Teredo navalis; this, however, being putrid, was washed out by the men who collected the specimens. All the shells were more or less mutilated, probably by the action of the waves, which had torn up large masses of coral and madrepore, during the continuance of the earthquake. The longest Mr. Griffiths procured was five feet four inches; some had the anterior extremity, others the posterior extremity broken. Most of the shells had the small cock's-comb oyster and various serpulæ adhering to their posterior extremity for more than a foot, proving that during their existence this part of the shell had protruded above the mud in which the remainder was buried. The specimens were milk-white externally, and tinged with yellow within; and the large or buried end was completely closed, and had a rounded appearance. The substance of the shell was composed of layers having a fibrous and radiated appearance, covered externally with a pure white crust. Many specimens were nearly straight, others more or less contorted.

Here then we have a gigantic Teredo, which bores not into wood, but into banks of mud in the sea, and lives after the closure of the buried extremity of its singular shell.

Fig. 3016 represents the Teredo gigantea as figured by Rumphius, with two terminal tubes, in which it differs a little from the specimens obtained by Mr. Griffiths, perhaps in consequence of a different kind of situation. The anterior extremity is closed.

Fig. 3017 is the Teredo gigantea, as figured by Mr. Griffiths. A, the small or upper end, protruding from the mud; the external covering is broken away, showing the termination of the tubes, one of which is broken: B, a longitudinal section of that part of the shell where the double tubes are formed: C, the shell complete, or nearly so, the upper extremity only being imperfect.

Fig. 3018, a transverse section of the shell, giving a front view of the orifices of the double tube, and showing the thickness of the shell at that part.

Fig. 3019, a transverse section of the shell at a thicker part, after it had been polished, showing the density of its structure, and giving a front view of the orifices into the double tube. The circumference at the base of a shell of five feet four inches was nine inches, but at this part its substance is thin. The apex with the double tube is brittle.

Family GASTROCHÆNIDÆ, GRAY (GASTROCHÆNA, CLAVAGELLA, &c.).

The family Gastrochænidæ comprehends part of the family Tubicolidæ of Lamarck, and is composed of tubular burrowing mollusks, of which we first select the Gastrochæna.

Of the genus Gastrochæna several species are known, and in the 'Proceeds. Zool. Soc.' 1834, pp. 21, 22, will be found the description, by Mr. G. B. Sowerby, of five species from the western coast of South America and the islands of the South Pacific.

In Gastrochæna there is a delicate bivalve shell, extremely gaping, with distinct umbones, a straight hinge, and an external ligament, and showing internally two muscular impressions. In this shell the mollusk is partially enclosed, with the lobes of the mantle united, (leaving only a small anterior opening for a conical foot,) and produced posteriorly into two united tubes.

To the shell is sometimes added a calcareous tube which envelops the valves, and lines the cavity of the stone into which the animal has penetrated. Cuvier says, it appears that the Gastrochænæ have uniformly a calcareous tube, but M. Rang states that this is not the case, though, like the Pholas, all burrow into stones. Sometimes, however, the animal burrows in madrepore, and sometimes not at all, but takes up its abode in old shells, as spondyli, and pearl-oysters, &c. M. Rang divides Gastrochæna into two sections: 1. species whose shell is smooth without a distinct tube.—Example, Gastrochæna cuneiformis; 2. species whose shell is striated from the umbo to the base, and contained in a distinct tube.—Example, Gastrochæna clava. This testaceous tube, it may be observed, the Gastrochæna forms either as a lining for the canal it has perforated, or as a covering for its shell

in those instances in which it has not perforated at all, but in which it has taken up its abode in the recesses of some empty shell. This will be best understood by reference to our pictorial specimens.

At Fig. 3020, A shows a group of the tubes of the Gastrochæna modiolina, Lam., from the Mediterranean. A has the tube broken, displaying the enshrouded shell in situ. B is a specimen of the anterior portion of a fossil spindle (Fusus Noæ), from Grignon, cut open and displaying the small elavate tube of a fossil Gastrochæna which had taken its lodgment there. C, a worn fragment of madrepore, broken open to show the tube formed by a specimen of Gastrochæna cuneiformis. D and E, the shell of Gastrochæna cuneiformis, in two views.

Fossil Gastrochænæ are not numerous; one species occurs in the inferior oolite.

We may here advert to the genus Fistulana, between which and the preceding the grounds of distinction appear to be somewhat doubtful. M. Deshayes, indeed, has proposed to sink the genus Gastrochæna, but, with the same views, M. de Blainville would, if both genera be inadmissible, rather suppress the genus Fistulana, because it was established subsequently to Gastrochæna; on the whole, however, he prefers its restriction, as in his 'Malacologie,' to its entire suppression. M. Rang observes that two of the species of Fistulana of Lamarck belong, as M. de Blainville correctly deems, to Gastrochæna, viz., Fistulana clava and Fistulana ampullaria. With regard to the latter, M. Deshayes, who retains it in the genus Fistularia, says, that according to circumstances it forms a free tube sunk in the sand, or, on the contrary, perforates calcareous bodies, its tube then serving as a lining to the cavity it inhabits. In the first case, therefore, this species would belong to Fistulana—in the second case, to the genus Gastrochæna, if indeed that genus must be preserved.

From all this, it appears that the two genera in question are mere sections of one generic group, by whatever title it may be considered most convenient to designate that genus.

Fig. 3021 represents the Fistulana elava, Sowerby; Gastrochæna clava, Rang and De Blainville.

This species is a native of the Indian Seas; it shrouds itself within a tube, always complete and free, and is found imbedded in sands or hard mud, with the small end of the tube uppermost.

Referring to the figures, A represents the tube of this species, which often presents a septum, seen at a; B, the valves of the shell, outside view; C, an internal view of the valves of the shell; D, apex of tube.

We may now turn to that interesting genus Clavagella, which has recently engaged the attention of some of the most scientific zoologists of Europe.

This genus was founded by Lamarck on eertain fossil species; and these only for many years were known as the only representatives of the form in question.

The first discovery of a recent species of Clavagella is due to Mr. George Sowerby, who detected a specimen enclosed in a mass of stone in the British Museum. Having obtained permission, he scraped away the stone, and thereby brought into view the shell, which, under the name of Clavagella aperta, the first recorded recent species, he described and figured in his 'Genera of Recent and Fossil Shells.'

Soon afterwards, 1827, the same zealous naturalist was enabled to add another reeent species to the genus. This was brought home by Mr. Stutchbury, who with some difficulty obtained three specimens at North Harbour, Port Jackson, during his voyage to Australia; they were embedded in a siiicious grit, and their presence was betrayed just beneath low-water mark by the jets of water which they forcibly ejected from their tubes. To this species Mr. G. Sowerby gave the name of Clavagella Australis.

In 1829 Mr. Stutchbury detected a Clavagella embedded in a mass of coralline, in the collection of Mr. J. L. Goldsmid, and to this Mr. Broderip gave the name of Clavagella elongata. (See 'Proceeds. Zool. Soc.' 1834, p. 116.)

Besides these, M. Audouin described a reeent species, and M. Rang another, under the title of Clavagella Rapa. (See 'Ann. des Sc. Nat.' tome xvii. p. 78; and Rang's 'Manuel des Mollusques,' 1829).

On the return of Mr. Cuming from his first voyage, among the valuable collection of that enterprising conchologist were specimens of Clavagellæ submitted to the inspection of Mr. Broderip. Of these one was embedded in a fragment of calcareous grit dredged up from a depth of eleven fathoms, at the island of Muerte, in the Bay of Guayaquil. This is described by Mr. Broderip as the Clavagella lata. ('Proceeds. Zool. Soc.' 1834.) The other species was from Malta, and is termed Clavagella Melitensis. ('Proceeds. Zool. Soc.') Mr. Broderip observes that "it is not impossible, from its locality, that this may turn out to be M. Audouin's species, if it should prove to be a true Clavagella." (See also 'Trans. Zool. Soc.' vol. i.

To these must be added two species from the Mediterranean, described, one, by Delle Chiaje, as Clavagella Sicula; the other, by Scacchi, as Clavagella Balanorum.

M. Cailliaud, in an admirable paper published in the 'Magazin de Zoologie,' 1842, in which he gives the results of his own personal observations on the species collected in the Mediterranean and Adriatic seas, refers the Clavagella lata, Brod., and the Clavagella Sicula, to the Clavagella aperta of Sowerby; the differences being the result of age, &c. If so, the distribution of the same species must be extremely wide. In the 'Trans. Zool. Soc.' vol. i. will be found an elaborate paper, by Professor Owen, on the anatomy of the Clavagella lata, Brod., from the specimen brought home by Mr. Cuming, who carefully placed the animal in spirits soon after its capture.

We shall not attempt to follow the Professor through his details, but content ourselves by referring to the specimens at Fig. 3022:— A, a part of the calcareous grit rock containing the fixed valve and part of the tube of Clavagella lata; C, an external view of the right or free valve; D, internal view of the same; B, the soft parts of the mollusk seen from the right side; the dermal layer of the mantle, e, being removed; E, the same seen from the left side, or that which is in contact with the fixed valve. The extremities of the left labial appendage are exposed, no part of the gill being protruded; a bristle (*) is placed at the opening of the mantle; a, the anterior wall of the chamber; b, dorsal wall, the latter placed on the hinge of the fixed valve; c, the ventral wall; d, the posterior or siphonic outlet; e, tubular communications with a neighbouring cavity, here set off from the posterior part of the mantle; e' e', calcareous tubes secreted by the above processes and extending into the cavities contiguous to the throat of the tube; e'', a cavity communicating with the anterior part of the chamber; f', impression of posterior adductor muscle; g', impression of anterior adductor muscle; h', impression of pallial muscle, or third adductor; f, posterior adductor; g, anterior or smaller adductor; h, pallial adductor; i, convex muscular mass, analogous to the muscular margin of the mantle lobes in other mollusks; k, muscular fibres of siphon; F, l, respiratory or injestive siphonic canal; m, ejestive siphonic eanal; n (E), labial appendage; t (B), the gills; x, part of egg-sac; G, anterior termination of shelly tube.

M. Cailliaud gives the following characters of Clavagella:—Shell bivalve, attached to a free tube in the fossil species, but in the living state included in calcareous masses or some marine production; the anterior part of the tube open, in the form of a ruffled chalice; the posterior part, excavated, oval, containing one valve free and another fixed to its wall; ligament external.

Mr. Broderip observes that we are left to conjecture the causes which operate to determine the animal in the ehoice of its abode, if indeed it can be called choice, for most probably Clavagella is the ereature of circumstanees, and if, soon after its exclusion from the parent (when Mr. Broderip supposes it to be furnished with its two valves only, and to float free with perhaps some voluntary impulse), it arrives at the vacant hole of some small Petricola, Lithodomus, or other perforating testacean which suits it, one valve soon becomes attached to the wall of the hole, and the animal proceeds to secrete the siphonic sheath or tube, to enlarge the chamber according to its necessities, and to form the shelly perforated tubular plate, which is to give admission to the water at the practicable part of the chamber. Though Mr. Broderip observes that the means by which the excavation is carried on are doubtful, he is inclined to attribute it to some solvent secretion of extensive power, the true nature of which is not known. In this opinion Mr. Broderip is followed by M. Cailliaud, who adduces many ingenious and forcible arguments in favour of these views, from facts which have come under his own observation.

At Fig. 3023 is represented a series of specimens of Clavagella aperta illustrating its growth: a is the right valve of a very young individual; b, the same more advanced, seen in the stone, which has been cut to show the excavated part, and the right valve in situ: its young tube has six facets and develops its first fimbriation or ruffle; c, the same still further advanced, also in the stone: its young tube has two ruffles; d, the same greatly increased and seen in the stone: a part of the mollusk is seen under the right valve, and in its excavation; also the great muscle of the mantle, and the aperture whence its small rudimentary foot comes forth. The lower extremity of the tube is laid open, to show the siphons terminating in papillæ. The tube presents five ruffles, and the commencement of two others, which the mollusk had not finished. Fig. 3024 is another specimen, which had entered the stone horizontally, and afterwards had prolonged its tube in a perpendicular direction; Fig. 3025, another specimen.

Figs. 3026 and 3027 are two specimens of the Clavagella Balanorum, imbedded in an agglomeration of Balini (sessile barnacles). A series of little tubes like fibres may be seen binding the animal in the upper figure to the base of stone.

M. Cailliaud observes that, both in the living Clavagellæ and also in the fossil species, small tubes often co-adapted (accolés) to each other, are placed in various parts of the cell. M. Rang believed that these served to give passage to so many fasciculi of byssus with which the animal is attached to the bottom of its dwelling. But M. Cailliaud remarks that this supposition eannot be allowed; for they would be entirely useless to the mollusk, which is sufficiently attached by its fixed valve. An attentive examination of these little tubes in living Clavagellæ has proved to M. Cailliaud that their use was not to afford a passage to the water, as has also been supposed, beeause in many of the excavations there are neither tubes nor any other communications; that the animal had no byssus; but that their utility was to fill the vacant spaces which the mollusk meets with in the stone, and which have sometimes been made by other perforating animals. Accordingly we perceive that these tubular reunions are always due to chance: one sometimes sees them at the bottom of the dwelling of the mollusk, sometimes in the walls; wherever in fact there is a necessity for elosing up, but never with any fixed character.

M. Cailliaud goes on to state that one of the most curious facts is the manner in which these small pipes are formed. The epidermis of the great muscle of the mantle is rough, covered with small pustules, whence fleshy filaments, like tentacles, occasionally come forth: these are so many instruments whence the secreting matter is poured out, and with which the mollusk forms those little tubes which are shown in the figure of Clavagella balanorum. M. Cailliaud had not been able to see them positively in action, when M. Scacchi of Naples twice surprised these animals in the act of introducing these fleshy filaments into the commenced tubes, which they secreted in a short time; many finished ones were already elosed, and when the work was completed these filaments retired into the epidermis of the great muscle, to reappear again when necessity required their aid.

We now pass to the genus Aspergillum (Les Arrosoirs of the French).

In this singular genus, the affinities of which were eorrectly appreciated by Lamarck, we find a mollusk sheathed in an elongated cone, closed at the large end by a disc, pierced with a great number of tubular orifices; the little tubes forming the outer row are the longest, forming a sort of eorolla round the disc. At a little distance above this base two small valves incrusted in the substance of the tube are easily distinguishable. Besides the little tubular processes of the disc, which, it would seem, contribute to support the Aspergillum upright in the sand, into which it is perpendicularly plunged, there is a small open fissure, admitting water into the dwelling, necesary perhaps, in low tides, when the upper extremity of the tube is above the level of the surface of the sea.

The animals of this genus are borers: some live in the sand, plunged down perpendicularly for about three-fourths of their length; some burrow in stone, others in wood, and others again in thick shells.

Fig. 3028 represents the Javanese Aspergillum, Aspergillum Javanum: a indicates the valves incrusted in the tube; b exhibits a front view of the disc.

This species is a native of the Indian Oeean. It attains to seven or eight inches in length.

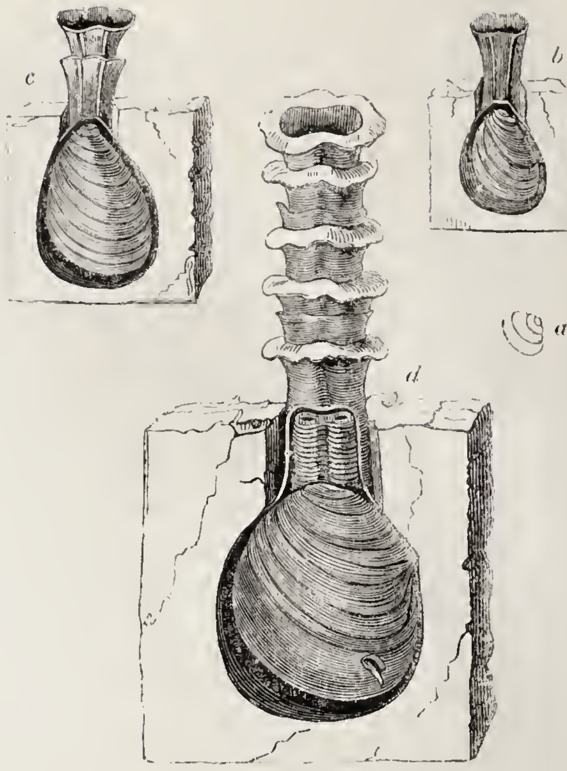
Fig. 3029 represents the Aspergillum vaginiferum: a, the two valves inerusted in the tube. This species inhabits the Red Sea, and has been found there by M. Rüppel.

Fig. 3030 represents the Aspergillum Novæ Zealandiæ: a, the valves incrusted in the tube; b, a front view of the disc.

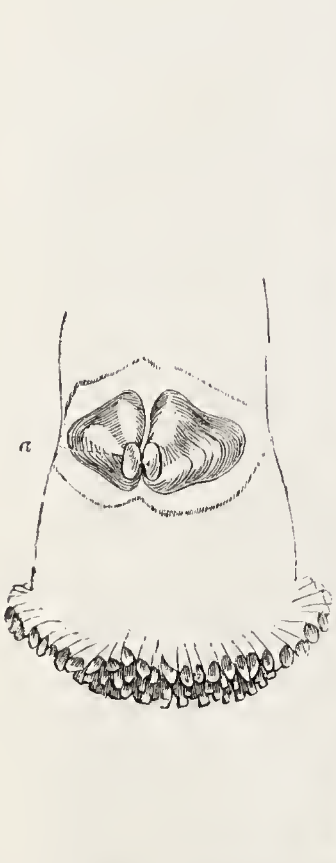
This species of Aspergillum occurs on the coast of New Zealand.

Here, then, we close our sketch of the Conchifera, the Acephalous Bivalve Mollusca; the leading structural points of which we trust we have not altogether failed in explaining. Let it be remembered that we write not for the scientific zoologist, but for those who desire a general acquaintance with the great groups of the animal creation.

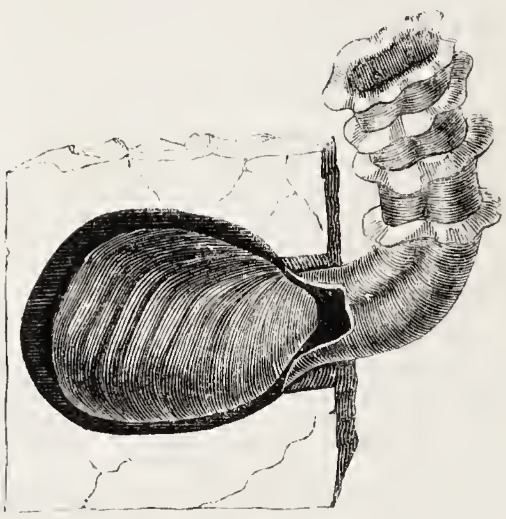
3022.—Clavagella.



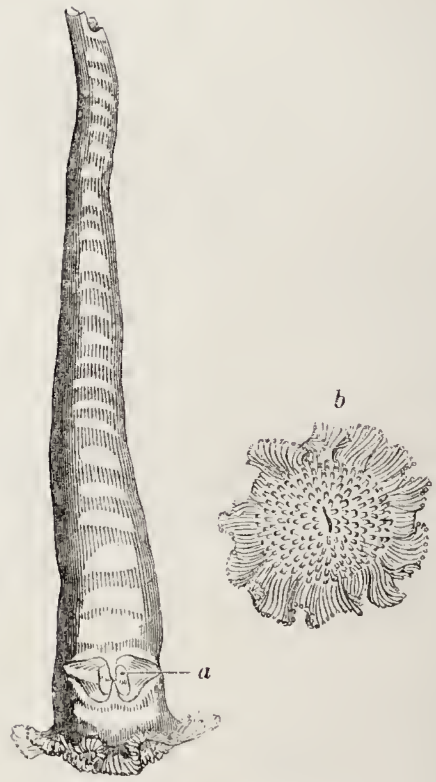
3023.—Clavagella aperta.



3029.—Aspergillum vaginiferum.



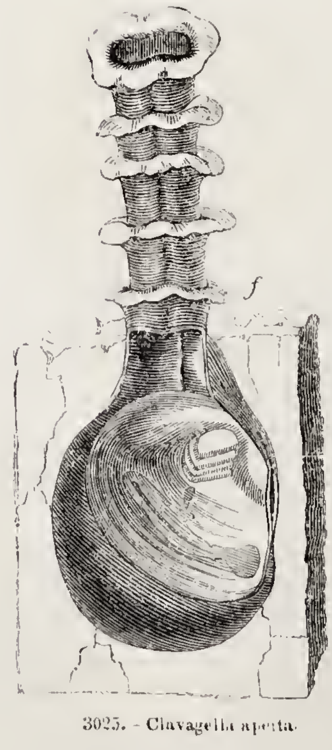
3024.—Clavagella aperta.



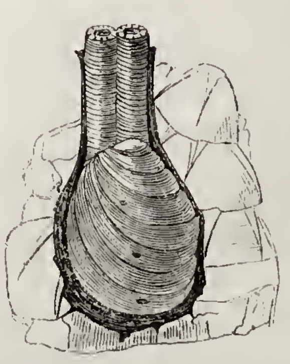
3028.—Javanese Aspergillum.

3026.—Clavagella Balnorum imbedded in Barnacles.

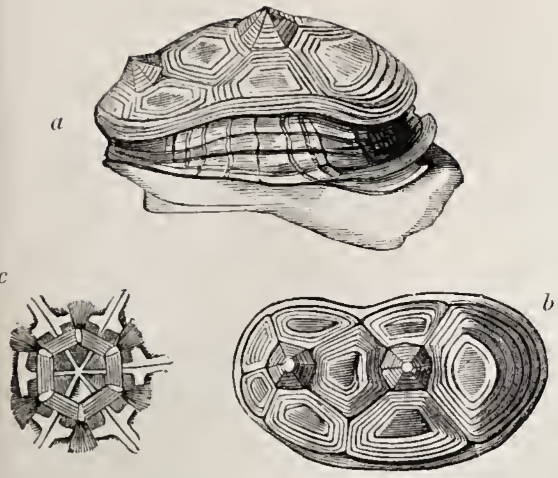
3030.—New Zealand Aspergillum.



3025.—Clavagella aperta.

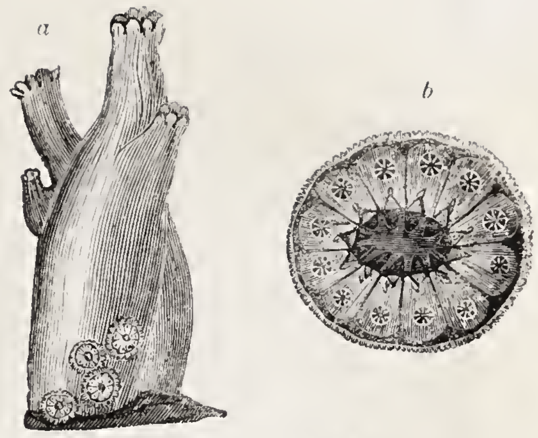


3027.—Clavagella Balnorum, and Barnacles.

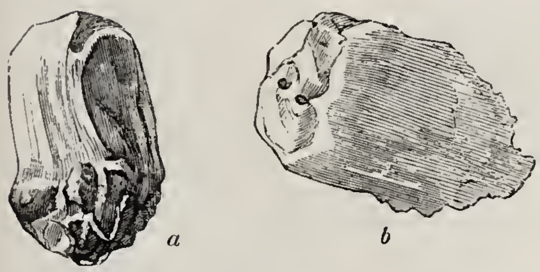


3036.—Chelyosoma MacLeayanum.

3046.—Tadpole of Amaroucium proliferum, magnified.



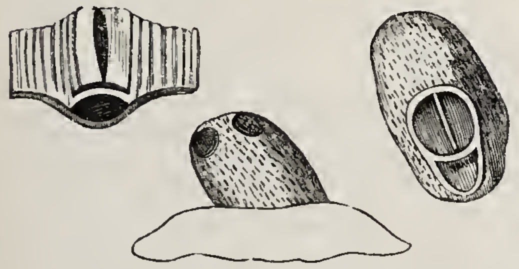
3031.—Botryllus stellatus, upon Ascidia intestinalis.



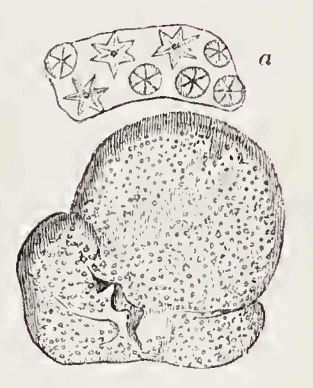
3033.—Dendrodoa glandaria.

3032.—Boltenia reniformis.

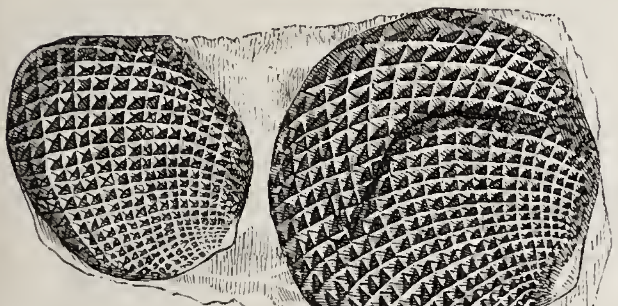
3045.—Portion of Amaroucium, magnified.



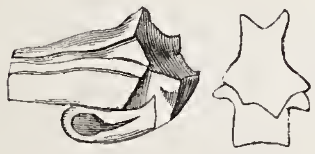
3034.—Fodia rubescens.



3042.—Synoicum ficus.



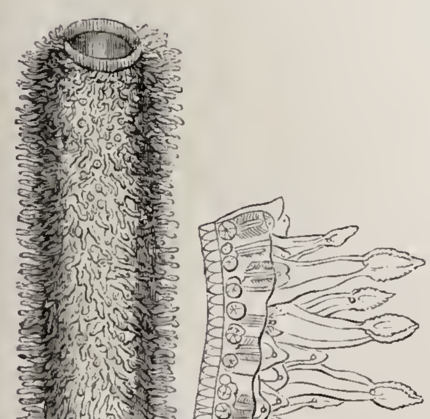
3047.—Ischadites Kōnigii.



3038.—Salpa polymorpha.

3044.—Amaroucium proliferum.

3043.—Synoicum turgens.

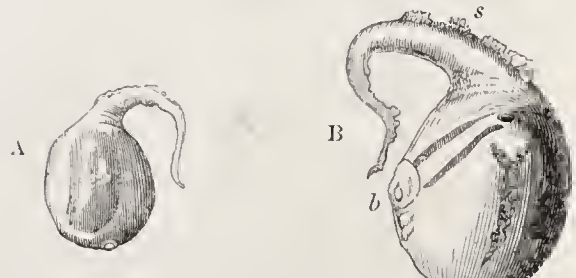


3041.—Pyrosoma giganteum.

3037.—Salpa firoloidea.

3039.—Salpa fusiformis.

3040.—Salpa Zonaria.



3035.—Cystingia Griffithsii.

CLASS TUNICATA

(*Les Acephales sans coquilles* of Cuvier; *Acephalophora heterobranchiata*, De Blainville). The Tunicata are mollusks enclosed not in shells, but in a sac or investment of a cartilaginous nature, and more or less flexible.

In the opinion of many naturalists the Tunicata form an intermediate link between the Conchifera, or bi-valve mollusks, on the one hand, and the Acrita (Polypes, jelly-fish, &c.) on the other. Their relation, says Mr. MacLeay, to the testaceous mollusca has been pointed out by Aristotle, Basta, Linnæus, Pallas, Cuvier, and Savigny: their relation to the polypes has likewise been shown by Savigny, when he demonstrated that the Alcyonium ficus of Linnæus is nothing else than an aggregation of minute Ascidiæ combined in a common envelope.

Strange and varied are the forms under which the Tunicata meet the eye of the naturalist, and diverse are their modes of life. Some, as the Ascidiæ, are fixed to the rocks; others, as the Salpæ, are free and swim about; others, as the Pyrosoma, are aggregated together, and form a sort of compound whole, floating with the current of the ocean. Others, again, clustered together and appearing like the rays of a star, as the Botrylli, are adherent to the bodies of other mollusks, or Ascidiæ and sea-weeds. See Fig. 3001, a group of Botryllus stellatus upon Ascidia intestinalis.

Cuvier divides the Tunicata into two sections: the first comprehends such as are isolated, that is, not organically aggregated to others of the same species, although they are often found clustered together; the second contains aggregated species, viz. those which are united into a common mass, organically bound together, as we shall find in many of the Acrita, or zoophytes.

In order that we may understand the general structure of the isolated Tunicata, let us select the Ascidia as an example.

The Ascidiæ (divided into several genera and subgenera) are fixed to rocks and stones; and, excepting by expansions and contractions, and by the forcible ejection of the water, they show but few external signs of life. In their appearance there is nothing very attractive; externally viewed they seem mere fleshy masses, with little to recommend them to our notice; but beneath this exterior will the zoologist discover a strange and beautiful organization, claiming the most minute scrutiny.

Let us suppose one of the fleshy-looking creatures of an oblong or sac-like form (see Fig. 3031, representing two specimens of Ascidia, one anterior to the other), fixed by its base to the surface of the rock. On examining it with a little attention, we shall observe an orifice at its very summit, and below this, again, a branching or prominent part, with an orifice also at its termination. Of these orifices the uppermost is the injestive orifice, leading to a delicate reticulated sac, performing the office of branchiæ. The lower or lateral orifice is the ejestive aperture.

Now the tunic or outer investment consists of a muscular layer with an epidermic membrane, and a delicate vascular serous lining, which at the orifices is reflected over the body of the enclosed animal; thus it hangs loosely, as it were suspended, in its sac-like case, by means of the reflected part of this peritoneal tissue.

We have said that the upper orifice leads to a delicate respiratory sac beneath the outer case or tunic; this sac is of circumscribed extent, very vascular, being covered with a network of vessels of infinite minuteness, and has its inner surface provided with minute and countless vibratile cilia, ever in action, and keeping up a perpetual current in the water imbibed.

The external orifice is surrounded by tentacula of great sensitiveness, which ascertain the presence of particles unfit for admission; the aperture thus rejecting some, but allowing the ingress of others; for, strange to say, the entrance to the œsophagus, that is, the real mouth of the animal, is at the bottom of this branchial sac. It appears that the nutritive particles taken in with the water are deposited on the ciliated surface, which they are made to traverse till they merge into a descending stream, which flows to the œsophagus, and thence into the stomach.

The stomach is simple, and receives through several orifices the biliary secretion: the liver is a glandular mass adherent to the stomach and alimentary canal. The latter is folded upon itself, and terminates, after emerging from the peritoneal investment, in a cavity communicating with the lateral orifice.

The circulating system is simple; the nervous system at a low degree of development. The egg-sac terminates in the same sac as the alimentary canal. The Ascidiæ are found in all seas, and valued in China as articles of food.

As an example of the Ascidian family we have already referred to the Ascidia intestinalis (Fig. 3031), and we may enumerate the genera Phallusia, Cynthia, Clavellina, Bipapillaria, &c. To this family must be referred the Boltenia reniformis (Fig. 3032), which presents a somewhat oval body or sac, affixed to the rock by means of a long slender peduncle. It is found in the northern seas of America. Referring to the figure, A is placed at the ejestive orifice; C, at the branchial orifice; P, at the peduncle.

Another genus is Dendrodoa, MacLeay, of which one species, Dendrodoa glandaria, is given at Fig. 3033: *a* represents the animal of the natural size: the base is incrusted with pebbles, and resembles the cup of an acorn; *b*, the same seen obliquely, so as to show the top, which is a little compressed. The orifices are minute.

In this family the Fodia rubescens (Fig. 3034) is also placed. It is of an oval shape, and is attached to stones by means of a kind of sucker. It is found on the coasts of North America.

We may also here notice the Cystingia Griffithsii, MacLeay (Fig. 3035), which in many particulars approaches the Boltenia. The peduncle is evidently the portion by which the animal is fixed. It is found in the northern seas of America (Winter Island, 'Captain Parry's Third Voyage'). A, the animal of the natural size, seen on the right side; B, the same magnified, seen on the left side; *a*, ejestive orifice; *b*, branchial orifice; *s*, grains of sand externally incrusting the thick end of the peduncle.

It is, perhaps, to this family that we must refer that singular animal the Chelyosoma MacLeayanum, Brod., a native of the Arctic seas, where it is found adhering to stones. The coriaceous envelope is laminated above, and modified into divisions like the back shell of a tortoise; and consists of eight somewhat horny angular plates, of which three surround the branchial orifice, and four the other. This species is represented at Fig. 3036: *a*, side view; *b*, seen from above; *c*, the interior of the upper plate.

Another family of the Tunicata is that of the Salpaceans (Les Biphores, Brug.; Thalia, Brown; Salpa and Dagysa, Gmel.). This family comprehends numerous species, many of which are so transparent that it is not always easy to discern them in a body of sea-water. They are free, not fixed, and are enclosed in a gelatinous cartilaginous tunic, of an oval or cylindrical form, and open at both extremities: that at the posterior extremity is large and furnished with a valve, which permits the entrance of the water, but prevents its exit, which takes place only at the anterior orifice. Hence by a series of dilatations and contractions, the water entering at one orifice, and being forcibly expelled at the other, the animals propel themselves along, the hind part foremost. Within the tubular cavity or canal through which the water passes is a vascular riband, attached by both its extremities to the walls of the canal, so that it is perpetually laved by the current as it passes; this vascular riband is the branchial apparatus. The viscera occupy a small cavity between the canal and the dorsal portion of the tunic near the mouth, which opens adjacent to the upper extremity of the branchial riband. In many species the tunic exhibits the most brilliant colours of the rainbow, while its transparence permits the internal parts to be perfectly visible.

The most extraordinary fact in the history of these yet imperfectly understood mollusks is that stated by Chamisso. According to this observer, Salpæ are found swimming in chains, the individuals comprising the chain adhering to each other apparently by means of minute suckers, but probably without organic union. These adherent Salpæ give birth to individuals of very different form, which are always isolated, but which produce concatenated Salpæ, and these concatenated Salpæ again produce isolated beings, and so on in alternate succession, generation after generation. Cuvier, who quotes Chamisso, says "It is certain that in some species may be seen young individuals in the interior of their parents, adhering together by means of a sort of minute sucker, and differing in form from the animals containing them." We have still much to learn of the economy of organic beings! The Salpaceans are found in the Mediterranean and the hotter latitudes of the ocean. Many are beautifully phosphorescent. Among the genera of this family may be mentioned Holothuria, Monophorus, Phylliroë, &c.

Referring to our pictorial specimens, Fig. 3037 represents the Salpa firoloïdea (genus Timoriensis, Quoy and Gaim.). It does not appear to be concatenated: the anterior extremity is very elongated and pointed. It is found in the seas of Timor, &c.

Fig. 3038 represents the Salpa polymorpha, Quoy and Gaim. It is angular and recurved, with the terminal orifices very much approximated. Whether it becomes concatenated or not is yet to be ascertained. The species is figured in two views.

Fig. 3039 represents one of the concatenated species, Salpa fusiformis, of which several are shown united together. The concatenated Salpæ form chains, often of many yards in length, and, as they are subject to the undulation of the waves, float along with a serpentine motion; the contractions of each individual are synchronous, and thus the chain winds its way over the surface of the sunlit ocean, like a long-drawn riband of silver.

Fig. 3040 represents the Salpa Zonaria, also one of the agglutinated species. The upper specimen shows several individuals united together, and below are two individuals disunited.

We may now pass to the Aggregated Tunicata, Les Aggrégés of Cuvier.

The Aggregated Tunicata are not united to each other by mere agglutination, but are conglomerated together into a single organic mass—a compound unity, and in this respect remind us of the coral polypes. Nevertheless it would appear from the observations of MM. Audouin and Milne Edwards, that the individuals of which any aggregated mass consists were produced from the egg distinct, and that they lived thus and swam about, not unlike tadpoles in form, vibrating a slender tail. Afterwards, however, at a certain period of their existence, they undergo a sort of metamorphosis, and numbers uniting together constitute one aggregated whole. In structure they approach more or less to the Ascidian mollusks. Some, however, as the Botrylli, with an opening at each extremity, may be regarded as aggregated Salpæ.

In the genus Botryllus the separated animals are of an oval form, and ten or twelve united together form a sort of star, which is fixed upon other bodies, and often on the Ascidiæ. The branchial orifices are at the extremity of the rays of the star, and the other orifices open into a common cavity in its centre. If the orifice of one individual be irritated, that animal exclusively contracts; but if the centre be touched, all contract together. Referring to Fig. 3031, several stars of the Botryllus stellatus are seen on a specimen of Ascidia intestinalis, *a*; *b* represents one of the stars or discs magnified.

Another group is represented by Pyrosoma, celebrated for its phosphorescence.

These singular creatures present the appearance of a simple gelatinous tube, rather larger at one end than the other. The tube varies in different species from one to six inches in length; it is hollow, with a distinct aperture at the larger end, and, as Cuvier and Rang say, closed at the other. Mr. George Bennett, however, describes the tube as open at both ends, the orifice at the smaller extremity being more contracted than that at the other.

Now the substance of this tube, if examined, will be found to consist of a multitude of buds, or gemmules, closely set together in a common gelatinous tissue; these buds are all distinct animals, each with its branchial orifice and viscera, and thus organically united, the tubular aggregation swims on the sea, by the combined contractions and dilations of the multitude working in unison, a continuous stream of water being propelled through the tube. Several species are described, as P. Atlanticum, P. elegans, P. giganteum, &c. Enveloped in a flame of bright phosphorescent light, and gleaming with a greenish lustre, the Pyrosoma presents a most brilliant appearance, and when seen at night in vast shoals upwards of a mile in breadth, and stretching out till lost in the distance, the glory of the spectacle may be easily imagined. The vessel, as it cleaves the gleaming mass, throws up strong flashes of light, as if ploughing through a liquid fire, which illuminates the hull, the sails, and the ropes with a strange unearthly radiance.

After death the splendour of the Pyrosoma vanishes, and gives place to a dull pale yellowish white. Fig. 3041 represents the Pyrosoma giganteum; *a*, a portion magnified.

Another group or family of this section, comprehending several genera, as Polyclinum, Synoicum, &c., presents us with species forming by aggregation fleshy masses, incrusting or rooted upon other bodies: some are elevated, the distinct animals forming branches; others have a sponge or fungus-like figure.

Fig. 3042 represents the Synoicum ficus: *a*, a portion highly magnified, showing the several individuals. Fig. 3043 represents the Synoicum turgens. Both are natives of the European seas.

Fig. 3044 represents an example of the genus Amaroucium, namely, A. proliferum, of the natural size. It is found along the coasts of the British Channel. Fig. 3045 represents a portion of the Amaroucium proliferum magnified.

We have already said that the young of the Aggregated Tunicata are free and independent, and not unlike the tadpole of the frog in form, though of extreme minuteness. Fig. 3046 represents the young of the Amaroucium proliferum highly mag-

nified: *a*, the tegumentary body of the trunk, which is seen within; *b*, the pouch or tunic enclosing the body of the young animal, which is surrounded by a nutritive vitelline fluid; *b″*, appendages terminating in suckers and enabling the animal to fix itself; *a**, the tail, formed by a prolongation of the tegumentary investment, and enclosing a tubular appendage of the vitelline sac. This tail is cast off when the animals quit the larva state and assume their sessile and aggregated condition.

It is to Milne Edwards that we owe our knowledge of the metamorphoses of these singular animals. See 'Ann. des Sci. Nat.' 1828, tom. xv., p. 10, and also the paper by Milne Edwards entitled 'Observations sur les Ascidies composées, des Côtés de la Manche,' read before the French Academy of Sciences, November 11, 1839, in which the physiology of these interesting animals is deeply investigated.

Fig. 3047 represents a fossil from the lower Ludlow rock, regarded as belonging to the Ascidian Tunicata.

Mr. Murchison remarks that these curious fossils are so grouped together, that he always compared them with packed or baked figs, and he says that Mr. König, to whom he referred them, thus speaks of them:—"I am of opinion that they may be considered to belong to the family of the Ascidiæ.... They seem to form a group of globular cariceous, and, it may be added, pedicled bodies, for in one of them the sicatrix (or mark) for the insertion of the pedicle distinctly appears. As, however, no traces of branchial or other apertures are to be found on the surface exposed to view, it would be rash to constitute this fossil a genus, or assign it a place in any of the known genera of naked mollusca." It is the Ischadites Königii of Mr. Murchison.

CLASS BRACHIOPODA, Cuv.

(*Palliobranchiata*, De Blainville, Owen, &c.). The class Brachiopoda, or Palliobranchiata, includes three groups, Terebratula, Lingula, and Orbicula, of which the species are all tenants of a bi-valve shell; but they differ so essentially from the ordinary mollusca of bi-valve shells, that their separation into a distinct class is abundantly justified. In common with the Barnacles, or Bernicles, the species of Lingula and Terebratula are affixed by means of a fleshy tubular pedicle to submarine bodies. In Orbicula, on the contrary, the pedicle is wanting, as in the Balani, and the lower valve of the shell becomes itself the medium by which the attachment of the animal to the rock is effected. In Lingula and Terebratula, the larger of the two shells is pierced at its summit or umbo for the passage of the pedicle.

The body of these mollusks within the shell is covered with a delicate mantle, lining the inside of the valves, and this mantle, which is traversed by blood-vessels, and furnished, especially along its edge, with vibratile cilia, constitutes the respiratory apparatus, whence the term Palliobranchiata (Pallium, a mantle), mantle-gilled.

In addition to this singularity of structure, the organs for procuring food offer many remarkable structural peculiarities.

They consist of two long spiral arms, one on each side of the mouth, and in many species these are capable not only of being unrolled, but extended beyond the shell to a great distance in quest of food. They are usually furnished with numerous vibratory filaments for the more certain capture of the prey. They also appear to act as oars, enabling the animal slightly to alter its position. It is to these arms that Cuvier's title Brachiopoda alludes.

In Terebratula the two valves are unequal, one being more convex than the other, and pierced at its apex with an orifice for the transmission of the peduncle, by which the animal is moored to stones, corals, &c. The other valve is flatter and imperforate, and presents us on its inner surface with a curious framework of shelly matter, consisting of a slender calcareous loop, fixed at its extremities to the lateral ridges of the hinge. This loop at first advances, and is then suddenly bent back upon itself, and at this point is attached to two processes, branching off from a raised line or ridge, running down the centre of the valve. This remarkable framework serves as a defence to the viscera, and as a support to the arms, which are fringed with long cilia. In some species, as T. chilensis and T. truncata, the arms are not extensile; but in T. Psittacea, of which Professor Owen, in the 'Trans. Zool. Soc.' vol. i., gives an admirable account, the arms are enormously developed, fringed along their outer margins, and quite free except at their origin. In their retracted state they are disposed in six or seven spiral folds, but when stretched forth extend beyond the shell to twice its length.

The mechanism by which these arms are unfolded is simple yet curious. The stem of each arm is tubular, and contains a fluid, which, acted upon by a multitude of muscles, forming the walls of the canal, and arranged spirally, is forced onwards up the tube, and thus the arm is expanded and protruded through the gaping valves.

The arms of these animals are essentially serviceable in procuring food, and having nothing to do, gill-like as they appear, with respiration or the renovation of the circulating fluids, for their cilia have horny texture, and do not exhibit any high degree of vascularity. Their object is by their movements to produce a current of water to the mouth, which hurries with it the nutritive particles with which the fluid is charged. We may here notice some remarkable muscular peculiarities in Terebratula. Two pairs of muscles arise from each valve, those of the imperforate valve at a distance from each other; one pair arise near the centre of the valve, and these converging unite below the stomach; these then divide and pass through the foramen of the perforate valve, to be inserted into the pedicle. The other pair are short and fleshy, and arise from depressions near the centre of the hinge; they are also inserted into the pedicle.

Of the perforate valve the muscles arise close together, so as to leave impressions on each side of a supposed median line; one pair is inserted into the pedicle, the others are adductors of the valves, and merely pass from the one to the other.

Fossil Terebratulæ are extremely numerous, and occur in abundance in some of the older strata to the supracretaceous group. The recent species are numerous, and widely diffused from the equinoctial to the polar seas. The depth at which they are found varies from ten to ninety fathoms.

Of the different variations of form presented by Terebratula and its subgenera our pictorial specimens will give a good idea.

Fig. 3048 represents the shell of Terebratula digona; the border is straight, as if cut off. It is only found in a fossil state.

Fig. 3049 is the shell of Terebratula globosa: a living species.

Fig. 3050 shows the valves of Terebratula dorsata; on the inner surface of one of which is seen the loop. It is one of the recent species.

Fig. 3051 is a fossil species, Terebratula deformis.

Fig. 3052 is another fossil species, Terebratula alata.

Fig. 3053 is Terebratula rubra, a recent species.

Fig. 3054 is the Terebratula Caput Serpentis, a recent species.

Fig. 3055 is the Terebratula Lyra, known as fossil, only.

Fig. 3056, Terebratula canalifera, fossil.

Fig. 3057 is the Strigocephalus Burtini, fossil.

Fig. 3058 is the Spirifer trigonalis, fossil.

Fig. 3059 is the Magas pumilus, fossil.

Fig. 3060 is the Producta Martini, fossil.

In the genus Magas the system of support is beginning to disappear, and in Producta the lower valve is not perforated at its summit, but is divided into two equal parts by a distinct transverse suture. (See Martin's Petrificata Derbiensia, t. 22, fig. 1, 2, 3.) It is here perhaps, as a link between Terebratula and Orbicula, that the genera Thecideum and Strophomena will range.

The genus Thecideum is characterized by the shell being equilateral, but very inequivalve: one valve is hollowed, the heel or hook recurved and entire, without fissure; the other flat, and without trace of internal support. The animal is unknown, but probably resembles that of Orbicula. One living species (Th. mediterraneum) is found in the Mediterranean. Fig. 3061 represents Thecideum radiatum; *a*, the natural size.

In the genus Strophomena the shell is subequivalve; one valve is flat, the other somewhat excavated. There is no trace of an internal support. No living species. Fig. 3062 represents the Strophomena rugosa.

We now turn to the genus Lingula.

In this genus the pedicle is very long, cartilaginous, and nearly cylindrical. The testaceous valves are somewhat elongated, compressed, truncated anteriorly, and acted upon by adductor muscles obliquely placed. On opening the valves the animal appears enclosed between two delicate membranes, forming the mantle. The margins of this mantle are thickened and fringed with delicate vibratile cilia. The mouth opens at the summit of a prominence, and on each side spread out the arms, which are fleshy, flat, and fringed; when contracted they roll up in a spiral manner, and can be uncoiled and protruded to a considerable extent from the shell.

The Lingula is generally supposed to be moored or attached by its peduncle, but in the specimen of L. Audebardii, examined by Professor Owen, there was no trace of the adhesion of any foreign body to the extremity of the peduncle.

Fig. 3063 represents the Lingula anatina, a native of the Indian seas. The valves are thin, horny, and greenish.

We now turn to the genus Orbicula.

In Orbicula there is no peduncle; and the two valves differ in form and size. One is conical and rounded, somewhat resembling the shell of a limpet, and has been regarded as a Patella by the older writers. The other valve is flat, with a fissure in the centre, for the passage of a ligament by means of which it is fixed to the rocks. As in Lingula, the mollusk has ciliated arms, rolled up spirally when withdrawn.

Fig. 3064 represents the Orbicula lamellosa. The cilia of the mantle appear protruded through the valves. The recent species of this genus are found attached to stones, shells, and sunken wrecks, at various depths to seventeen fathoms. The Orbicula lamellosa is a native of the coasts of Peru; it was found by Mr. Cuming in groups, the individuals being in many instances piled in layers one over the other, on a sandy bottom at a depth ranging from five to nine fathoms. At Ancon they were found attached to dead shells, and also clinging to the wreck of a Spanish vessel, of about three hundred tons, which went down in the bay about twelve years ago. The sunken timbers, for the sheathing was gone to decay, were covered with these shells much in the same way that beams on land are sometimes invested with flat parasitic fungi. At Inquiqui they were taken adhering to a living Mytilus. See 'Proceeds. Zool. Soc.' 1833, p. 124, and also 'Trans. Zool. Soc.' i., for descriptions by Mr. Broderip of several new species of Terebratula, Orbicula, and Lingula. Fossil species occur in the greensand, oolite, and carboniferous limestone.

The genus Crania is placed here by most zoologists. The upper valve is pateliiform, the lower valve is attached by its outside, the greater part of it being generally extended over the substance to which it adheres. There are four muscular impressions on each valve.

Fig. 3065 represents the Crania personata, the only living species known. It dwells at great depths, adhering to stones and shells; and has been dredged up in two hundred and fifty-five fathoms of water.

Fossil species of this genus are found in the chalk. Referring to Fig. 3065, *a* shows the shell viewed externally; *b* and *c*, inside views of the flat and concave valves. In the 'Trans. Zool. Soc.' vol. i., is an admirable paper on the Brachiopoda, by Professor Owen, to which we have already alluded; and to which we refer our readers for more full and minute details.

Here perhaps we ought to close the subkingdom Mollusca, or Heterogangliata, Owen; for the singular group of animals upon the general history of which we are about to enter, though referred to the Mollusca by Cuvier and preceding zoologists, cannot but be regarded as coming within the pale of the Crustacea, between which and the Annelids it appears to form a link of union. Cuvier, who was well acquainted with the nervous system of the animals of the group in question, namely, the Cirrhopods or Cirripeds (bernicles, acorn-shells, &c.), observes that they constitute in many respects an intermediate link between the Mollusca and the Articulata (crabs and other Crustacea); yet we incline to the views of Martin-Saint-Ange, who considers their situation to be between the Crustacea and Annelids —and were we devoting this work to an exposition of the scientific arrangement of the animal kingdom, such would be the station in which we would place them. As this, however, is not our object, and as zoologists are divided in their views on the subject, we shall treat of them as a class *per se*, and leave their situation open, only observing that while Martin-Saint-Ange considers them as Annelidian Crustacea, M. de Blainville regards them as Crustaceous Mollusks.

CLASS CIRRHOPODA.

THE Cirrhopoda (Cirrhipeda, Cirripeda, or Cirripedia) were all included by Linnæus in the genus Lepas, and placed among the Multivalves of his Vermes, between Chiton and Pholas; and when we reflect that their anatomy was not understood, we shall not be surprised at his arrangement. This class may be divided into two great sections, viz., the Pedunculated Cirrhopods (Campylosomata, Leach), and the Sessile Cirrhopods (Acamptosomata, Leach).

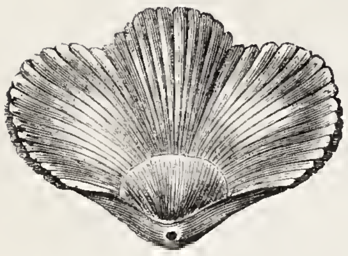
All are marine: in figure more or less conical; often compressed, and enclosed in a shell, of variable form, and composed of many pieces, either soldered or not soldered together. In one case only there is no true shell, but a soft envelope in lieu of it. The shell, or its representative, is either adherent to foreign bodies by the intervention of a fleshy peduncle issuing from the mantle, or is sessile and without a peduncle. Within the shell the body is invested with a sort of mantle, open on one side. There is no distinct head; no eyes, and no true tentacula; but from the apical portion of the body emerge a certain number of jointed and ciliated cirrhi. The

3060.—Producta Martini.

3048.—Terebratula digona.

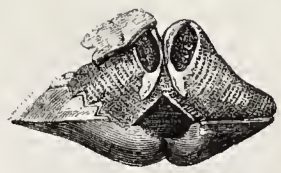
3056.—Terebratula canalifera.

3050.—Terebratula dorsata.

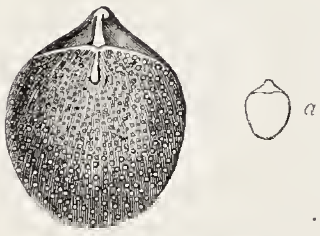


3052.—Terebratula alata.

3063.—Lingula anatina.

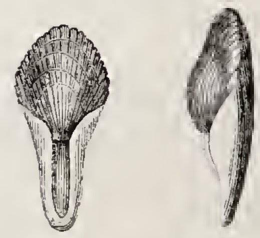


3058.—Spirifer trigonalis.



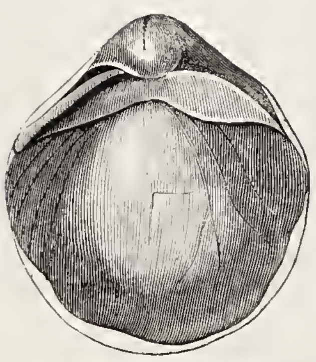
3061.—Thecidium radiatum.

3059.—Magas pumilis.

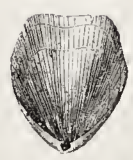


3055.—Terebratula Lyra.

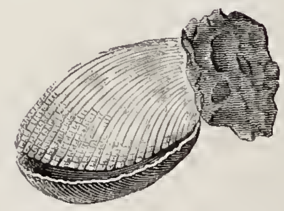
3065.—Crania personata.



3057.—Strigocephalus Burtini.



3054.—Terebratula Caput Serpentis.



3053.—Terebratula rubra.

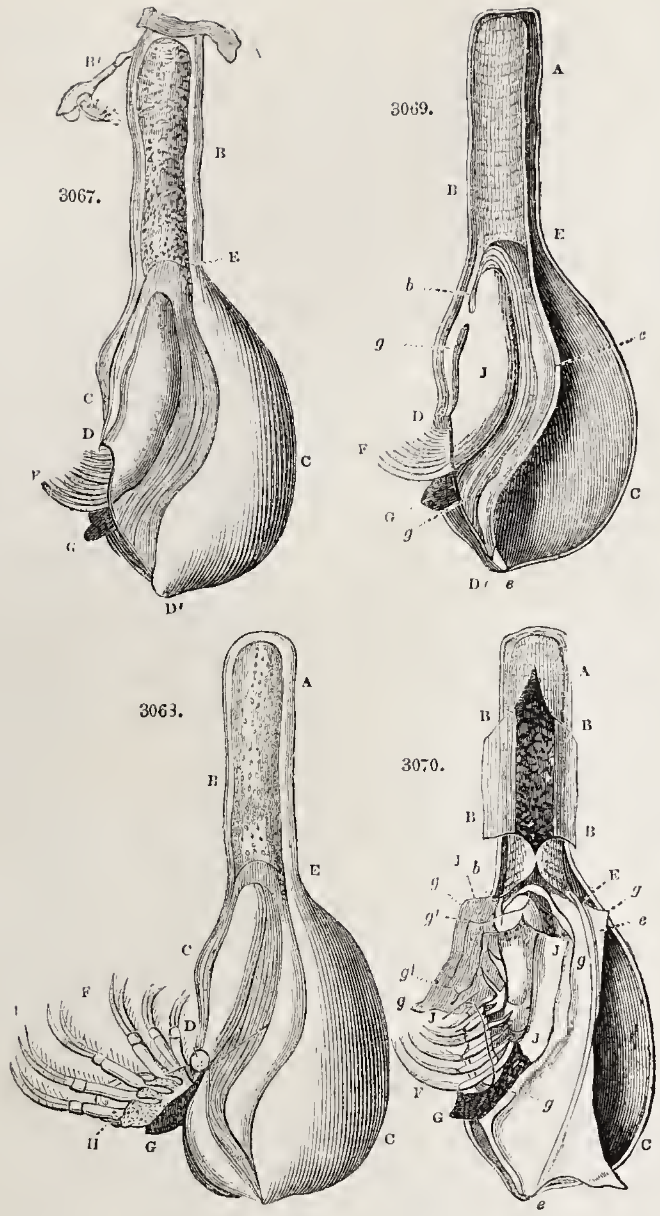
3062.—Strophomena rugosa.

3064.—Orbicula lamellosa.

3049.—Terebratula globosa.

3051.—Terebratula deformis.

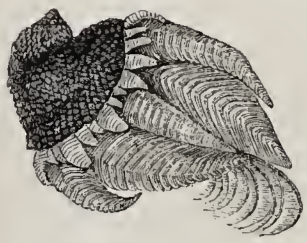
3080.—Scalpellum vulgare.



3067 to 3070.—Anatomy of Bernicle.

3077.—Gymnolepas vittata.

3081.—Valves of Scalpellum vulgare.



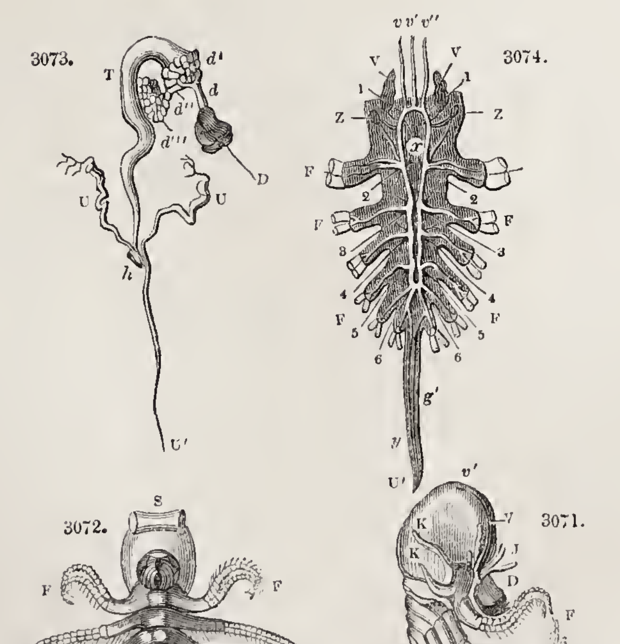
3079.—Polliceps Mitella.

3076.—Gymnolepas Cuvieri.

3082.—Lythotrya dorsalis.

3075.—Alepas parasita.

3078.—Duck Bernicle.



3071 to 3074.—Anatomy of Bernicle.

3066.—Common Bernicle.

mouth is furnished with lateral horny, toothed, and articulated jaws. The branchiæ are on each side of the base of the first cirrhi. The nervous system consists of a double cordon, with ganglia, giving off fibres to every part. But leaving these generalizations, let us take one of these animals and examine it, with a view to a more clear and definite idea of the group in question. We will take the Common Bernicle, Pentalismis anatifera (Lepas anatifera, Linn.). The Bernicle, Fig. 3066, is widely spread, and clusters of these strange creatures may be seen adherent to floating logs of wood, the timbers of wrecked vessels, the sides of rocks, and other objects affording a secure attachment. Each individual consists of a body enclosed in a shell, not unlike that of a mussel in figure, and of a fleshy worm-like stem or peduncle, the extremity of which is fixed to the object upon which the animal is stationed. This stem is tubular, tolerably firm, and has a fleshy feel; it is composed exteriorly of a fine coriaceous outer membrane, bedewed with a watery fluid, and beneath this, of an inner membrane of considerable density, apparently consisting of muscular fibres, running for the most part in parallel longitudinal lines. That these fibres are muscular we may conclude from the animal having the power of contracting the stem, or of twisting it in various directions. Within the tube there is a fluid secretion.

The body, as we have said, is enclosed in a shell; and this shell is composed of five pieces. Four pieces are lateral, two on each side; while between the valves down the back is interposed a single narrow slip uniting them together. Their colour is white, more or less tinged with purplish blue. Along the anterior margin the valves are but partially connected by membrane, leaving a large fissure, through which emerge the plumose and jointed arms or cirrhi.

Removing the shell so as to expose the body, we find it enveloped in a fine membranous mantle; at its apical portion are the jointed cirrhi in two rows, each row consisting of six pairs of these appendages, and each rises from a single stem or footstalk at the base. The apical pairs are the longest; the others decrease in rotation. They are based on decided articulations of the body, and the shortest pair are regarded by some as the analogues of the jaw-feet (pieds-mâchoires) of Crustacea. In each of the cirrhi is a double canal, for establishing a circulating current, traversing all their joints. Between the base of the shortest cirrhi, or pieds-mâchoires, are certain pyramidal fleshy appendages, like the radii of a minute starfish, and which are regarded as branchiæ, though the cirrhi are also, perhaps, aërating organs.

The mouth is placed at the lower part of the fissure through which the cirrhi are protruded, and terminates a raised tubercle or prominence. It is furnished with a horny lip, having minute palpi, and with three pairs of mandibles, of which the two external are horny and serrated, the internal soft and membranous. In these triple jaws, we trace a decided analogy to the Crustacea, while the cirrhi represent the true and false limbs of these animals, and the fleshy appendages their branchiæ.

From the symmetrical arrangement of the cirrhi we might expect to find a similar disposition of the nervous system, and accordingly, as in Crustacea, we find it homogangliate—that is, composed of ganglia or knots, and symmetrical nervous threads. Four œsophageal ganglia give origin to four nervous cords proceeding to the muscles and viscera. A double cord, connected by ganglia, is continued down the ventral aspect of the body, supplying the cirrhi.

The mouth leads to a short firm œsophagus, which receives a supply of saliva from two large glands, and enters a capacious stomach with sacculated walls, and surrounded by the liver—a mass of minute sacculi; the alimentary canal is simple; it runs along the dorsal aspect of the body, and terminates at the root of a tail-like prolongation, between the two longest cirrhi.

The food of the Bernicles consists of small Crustacea and mollusks; these are entangled by the many-jointed plumose cirrhi, which are perpetually thrown out and folded again, so as to serve the purpose of a casting net, and drag the prey to the mouth, where it is seized and crushed.

Of the blood-vessels little is known. With regard to the reproduction of these creatures, the eggs are seen enclosed at certain times within the hollow of the peduncle, where they appear of a blue colour, and render the pedicle opaque; from this they pass through a minute conduit into the cavity of the mantle, where they are arranged like two leaflets, attached to the septum between the body and the peduncle. They are enclosed in a film, out of which they fall when ready to hatch. At first these leaflets of eggs are small, and blue; as they increase, they loss that tint and assume a tinge of pink, and at last become nearly white.

We may now turn to our specimens. Figs. 3067 to 3074 are illustrative of the organization of the Bernicles. They are from a shell-less species of the genus Alepas.

Fig. 3067: A is a gelatinous production of the horny envelope which serves to attach the peduncle. B′, a small individual affixed, as is often seen, to the pedicle of the parent. B, the first membrane of the pedicle. C, the convex part, containing the body of the animal. D, the fissure from which the cirrhi protrude. F, the cirrhi. E, the termination of the pedicle, where the eggs stop. G, the eggs arrived within the mantle.

Fig. 3068, the same letters refer to the same parts as in Fig. 3067. H, the part of the feet which sustains the cirrhi.

Fig. 3069, the same, with the interior more exposed. *e*, *e*, the canal which carries off the peduncle within the mantle; *b*, a nutrient vessel to the peduncle and eggs; *g*, *g*, the membrane of the mantle, which intercepts direct communication between the peduncle and the cavity of the mantle. J, represents the body enclosed in its proper envelope.

Fig. 3070, the same more displayed. B, B, the muscular tube open, in which the eggs are seen. *e*, *e*, the course of the egg-duct in the thickness of the second envelope; *g*, *g*, *g*, the envelope opened and turned back. J, J, J, the proper membrane of the body of the animal. It is between this membrane and that of the envelope, g', g', that the eggs are found.

Fig. 3071, a side view of the Common Bernicle (Pentalismis anatifera) taken out of the shell, enveloped in its proper membrane. V, the cervical ganglion; v', the nerve which is given off from it to go to the muscles of the skin. J, the two levator muscles of the lower lip. K, K, branchiæ; *h*, a horny tubercle on each side of the egestive orifice. U′, the extremity of the articulated tube, tipped with fine hairs. It contains a canal opening at its extremity by a minute orifice, and receives at its base two vesiculæ.

Fig. 3072, anterior view of the same, showing the articulated disposition of the body, each ring of which corresponds to a pair of feet. S, the adductor muscle of the valves; F, the cirrhi.

Fig. 3073, the digestive apparatus. D, the mouth; *d*, the œsophagus; d', the stomach; d'', the little tube communicating with a kind of sacculus, d''', of the same structure as the stomach. T, alimentary canal; *h*, terminal aperture. UU, certain vesiculæ, uniting in a single canal and terminating at U′ by a small orifice.

Fig. 3074, disposition of the nervous system. 1, first œsophageal ganglion, with branches v, v', v'', destined to muscles of the dorsal part. V, salivary glands supplied by a minute nerve. Z, nervous ganglia; 2, 3, 4, 5, 6, other ganglia giving nerves to the feet; g' and y, two threads given to the articulated or caudal tube; x corresponds to the centre of the œsophagus, which has been removed.

It is from Mr. Thompson that we learn the extraordinary fact that the young bernicles and other Cirrhopods on emerging from the egg are quite free, and very different from their parents. They possess locomotive organs, consisting of a large anterior pair of limbs, provided with a sucker, and hooks for the purpose of mooring themselves at pleasure to various objects—and also of six pairs of swimming-limbs, acting in concert like oars. Besides these they have a tail bent under the body, consisting of two joints and terminating in four bristles; this is an additional locomotive organ. Thus endowed they swim along in a series of bounds, the oars and tail going in measured time successive impulses. They have, moreover, large lateral eyes set on peduncles, and the body is covered with a sort of shell, as we see in certain Crustacea (Cyclops, &c.), which they closely resemble, and for which Mr. Thompson at first mistook them.

In due time a metamorphosis takes place; the shell is thrown off, the eyes disappear, the limbs become transformed to cirrhi, the regular valves develop themselves, the peduncle shoots forth, and the animal becomes permanently fixed.

Believing these little creatures to be the larvæ of some crustaceous animal, some of them, says Mr. Thompson, "were collected in the spring of 1826, and, in order to see what changes they might undergo, were kept in a glass vessel, covered by such a depth of sea-water that they could be examined at any time by means of a common magnifying glass; they were taken May 1, and on the night of the 8th the author had the satisfaction to find that two of them had thrown off their exuviæ, and, wonderful to say, were firmly adhering to the bottom of the vessel and changed to young barnacles, such as are usually seen intermixed with grown specimens on rocks and stones at this season of the year (Balanus pusillus, Penn.). In this stage the sutures between the valves of the shell and of the operculum were visible, and the movements of the arms of the animal within, although these last were not yet completely developed; the eyes also were still perceptible, although the principal part of the colouring-matter appeared to have been thrown off with the exuvium (exuviæ). On the 10th another individual was seen in the act of throwing off its shell, and attaching itself as the others to the bottom of the glass. It only remains to add, that as the secretion of the calcareous matter goes on in the compartments destined for the valves of the shelly covering, the eyes gradually disappear, from the increasing opacity thence produced, and the visual ray is extinguished for the remainder of the animal's life; the arms at the same time acquire their usual ciliated appearance. Thus then an animal originally natatory and locomotive, and provided with a distinct organ of sight, becomes permanently and immovably fixed, and its optic apparatus obliterated; and furnishes not only a new and important physiological fact, but is the only instance in nature of so extraordinary a metamorphosis.

"During the whole of the spring and summer months the water teems with these exuviæ of Tritones (the animal inhabitant, according to Linnæus, of the barnacles): it is impossible to avoid drawing up numbers every time a towing-net is thrown out; nay, the tide is at times discoloured from their abundance; but to be certain that these are really such, let a stone with several barnacles upon it be kept in sea-water, regularly renewed, towards the latter end of April or the beginning of May, and with due attention many of them may be observed in the act of throwing off exuviæ in every respect identical; let it be recollected however that these are the casts of the animal alone, and not of the valves of the shell, or of the operculum."

These researches were followed up by Mr. Thompson, and in a paper read before the Royal Society on the 5th of March, 1835, he detailed his discovery of similar transformations in the young of the pedunculated Barnacles (see 'Phil. Trans.' Pl. II. 1835). His first observations have been confined to the young of the sessile Balani. The following is an abstract of the paper:—

"The larvæ of this tribe, like those of the Balani, have the external appearance of bivalve monoculi, furnished with locomotive organs, in the form of three pairs of members; the most anterior of which are simple, and the other bifid. The back of the animal is covered by an ample shield, terminating anteriorly in two extended horns, and posteriorly in a single elongated spinous process. Thus they possess considerable powers of locomotion, which, with the assistance of an organ of vision, enable them to seek their future permanent place of residence. The author is led from his researches to the conclusion that the Cirripedes do not constitute, as modern naturalists have considered them, a distinct class of animals, but that they occupy a place intermediate between the Crustacea decapoda—with which the Balani have a marked affinity—and the Crustacea entomostraca, to which the Lepades are allied; and that they have no natural affinity with the testaceous mollusca, as was supposed by Linnæus, and all the older systematic writers on zoology."

With respect to the inference deduced, viz., that these animals are not related to the testaceous mollusca, there is, as we have said, much difference of opinion, but the point at issue we shall not attempt to moot. Turning first to the Bernicles, or pedunculated species, we may observe that they are widely spread, and adhere to submarine bodies in considerable numbers. They have been found not only on floating wood, the hulls of ships, bottles, and other articles drifting about, but on shells, on turtles, whales, and even sea-snakes. We have seen a large log of timber completely covered by them, so that it was hidden entirely; to see thousands of these creatures all compacted in close array, writhing and twisting about, was a singular spectacle; it reminded us of Medusa's head, serpentibus horridum.

It would appear that the growth of these animals is very rapid, for a ship perfectly free from them will often return after a short voyage covered with them below the water line. The negroes of Goree are said to eat a large species of Pentalasmis, which it is reported is of delicate flavour.

We may now turn to our pictorial specimens illustrative of the genera into which the pedunculated group is divided, and first we notice Alepas.

In the genus Alepas the general figure of the body is oval and compressed. There is no shell, its place being taken by a subgelatinous and somewhat transparent envelope, continuing itself with the peduncle. The individual on which M. Rang founded the genus was attached to the umbrella of a Medusa. Fig. 3075 represents the Alepas parasita.

The next genus, Gymnolepas, is divided by Dr. Leach into two subgenera, Otion and Cineras. The pedicle is long, the shell merely rudimentary. In Otion there are two auriform tubes attached to the outer investment of the body. Fig. 3076 represents the Otion Cuvieri (Gymnolepas Cuvieri). It is a

native of the warmer parts of the ocean, and has been received from the coasts of Senegal. In the Museum of the Royal College of Surgeons is a fine group of these animals attached to a large sessile species (Coronula diadema) which is a parasite of the South Sea whale: *a*, the animal attached; *b*, the small lateral valves; *c*, the single valve; *d*, the terminal valves.

In Cineras there are no auriform tubes, and the form is more angular. Fig. 3077 represents the Cineras vittata (Gymnolepas vittata): *a*, the animal; *b*, the lateral valves; *c*, the single valve; *d*, the terminal valves. This species is a native of the Indian seas. In the Museum of the Royal College of Surgeons there is an allied species termed Cineras Hunteri, of which two small groups are attached to the tail of a sea-snake (Hydrophis bicolor). We turn next to the genus Pentalasmis (Anatifa, Lamarck, Pentalepos, De Blainville).

In this genus the shell is well developed, and consists of five pieces: the peduncle is elongated.

Fig. 3078 is the Common or Duck Bernicle, Pentalasmis Anatifera (Lepas Anatifera, Linnæus), which is also represented at Fig. 3066.

This species is widely spread, being carried attached to floating objects from sea to sea. On the coast of Africa it is very abundant. It is this species which was formerly regarded, not only by the ignorant, but even by men of education, as the young of a species of goose, into which it ultimately became transformed. An account of this absurd error is given in our notice of the Bernicle Goose (Anser Bernicla) in vol. ii. p. 51. It affords one proof, amongst many others, of the general ignorance which formerly prevailed, and which is but now passing away, with respect to the laws of organic life. Nature was then but little studied, nor can we wonder that those who believed in witchcraft, necromancy, and astrology should readily credit the tale of bernicles turning into geese, attested as it was by so many authorities. The story would class well, in the Metamorphoseôn of Ovid, with those of the coral turning to stone, of snakes produced from the spinal chord of human bodies, and of hornets bred from dead horses.

The genus Pollicipes next requires our notice.

The animal resembles Pentalasmis, but the pedicle is shorter, and rough like shagreen; the shell is triangular, and, besides the principal side valves, is furnished with a number of accessory pieces fixed at their base; they are marked with transverse striæ, and are pointed. Fig. 3079 represents the Pollicipes Mitella, a native of the warmer seas.

Allied to the preceding genus is that termed Scalpellum (Polylepas, De Blainville). In this form the peduncle or pedicle is short and sealy. The shell consists of thirteen pieces, six of which on each side form a sort of composite valve, and between these valves is the dorsal piece. Fig. 3080 represents the Scalpellum vulgare, common in the seas of Europe, attached to fronds, corals, &c.—a group of four are given thus affixed. Fig. 3081 is a view of the composite valves.

An allied species is found in the Straits of Magelhaens. The next genus is regarded by Mr. Sowerby as intermediate between the sessile and pedunculated cirrhopods; its shell is regular, subpyramidal, and compressed; the valvular pieces are eight, with a shelly plate at the base analogous to that of Balanus. The peduncle is tendinous.

This genus is termed Lithotrya by Mr. Sowerby, a title which M. de Blainville has changed, we know not why, for Litholepas; though he quotes Mr. Sowerby's description, and states that he has never seen the animal.

The Lithotrya dorsalis (Fig. 3082) is remarkable for living imbedded in stones, the valves only appearing externally; but whether it perforates holes for itself, or occupies those which have been worked out by some mollusk, is not at present determined. It has been found at Montserrat, one of the Antilles.

Cuvier in his 'Règne Animal' notices a genus called by him Tetralasmis, in which the valves are four only in number, and the peduncle, which is large, is covered with hairs. The species he describes as Tetralasmis hirsutus.

Leaving the Pedunculated Cirrhopods, let us now turn to those which are sessile.

The Balani, or acorn-shells (Les Glandes de Mer) essentially agree with the Bernicles; they have, however, no peduncle or footstalk, but are sessile, that is, immediately fixed upon the substances to which they attach themselves, or in which they are more or less imbedded.

We often see the shells of mussels and oysters covered with balani densely crowded together. If by way of example we examine these balani, we shall find them to be shrouded in a cone of hard calcareous matter, composed of various pieces, accurately fitted together, and enlarging with the growth of the animal. A thin calcareous base or closing plate fixes the cone to the substance on which it rests. Its apex presents four species so arranged as to form an operculum or valvular lid, shutting up the hollow cone when the animal retires, but capable of being opened for the protrusion of the cirrhi.

From the restricted genus Balanus, several genera are separated by modern naturalists, according to characters represented by the cone, and its operculum. These animals were well known to the ancients, and the larger species were regarded as delicacies. At the present day the Chinese eat the flesh of the Balanis Tintinabulum, which when cooked has, it is said, the flavour and delicacy of a lobster, and the Balanus Psittacus is regarded at Valparaiso as a luxury.

The genus Pyrgoma, which we may first notice, has the cone formed of a single piece, open at the apex, thick and compressed. The base is closed by a cup-shaped plate; the operculum is bipartite, each part consisting of two valves, which are variable in form, the posterior one being in some species much elongated.

The species of this genus are found either adherent to or imbedded in corals, and not unfrequently are overgrown by them, and so buried.

Fig. 3083 represents the Pyrgoma crenatum; at *a*, specimens are seen of the natural size in a madrepore, the astræa favosa; *b*, *c*, and *d*, are different views and sections of the cone magnified; *e*, the opercular valves magnified.

In the genus Clitia, the shell consists of four irregular pieces, two large, and two smaller, dovetailed together by their dentated edges. The operculum is bivalve, one portion being irregularly quadrate, the other nearly triangular.

Fig. 3084 represents the Clitia verruca (Lepas striata of Pennant, Lepas verruca of Gmelin), somewhat enlarged. It is a native of the European seas, and is found on the British Coast.

We now pass to the genus Creusia; we find here the cone quadrivalve, the pieces unequal, the base deeply cup-shaped. Like the Pyrgomata, these shells are affixed to, or imbedded in madrepores, and other corals.

Fig. 3085 represents the Creusa gregaria; *a*, the shell of the natural size imbedded in madrepore; *b*, *c*, *d*, the cone in different views magnified, latter a section; *e*, the opercular valves magnified.

The genus Conia, to which we turn next, presents us with a pretty species, the Conia porosa (Fig. 3086) found in the Mediterranean, the West Indian and other seas. The shell is subconical, composed of four subtriangular valves, with longitudinal phiæ highly developed. The operculum consists of four pieces.

We now turn to the genus Tubicinella. In this form the shell is subcylindrical; the cylinder, which is truncated at both ends, is formed of six pieces, smooth within, but longitudinally striated, and marked by distinct elevated rings externally; so as to bear some resemblance to the windpipe of a quadruped. Beneath it is closed by a membrane. The operculum is composed of separate pieces not articulated. But one species of this genus is known, the Tubicinella Balænarum (Fig. 3087). It is parasitic, infesting the bodies of whales, which are sometimes seen studded by it in incredible multitudes, to the great suffering, one would suppose, of the huge monsters of the deep, in whose skin and fat these creatures bury themselves almost to the summit of the aperture of the shell. The rings mark the successive stages of growth in this cirrhopod; their number therefore is variable. Another parasitic genus is that termed Coronula (Chelonobia, Leach; Cetopirus Ranzani, Diadema, Schumacher). In Coronula the shell is partially orbicular, and is composed of six unequal ribbed pieces, so completely soldered as to present the appearance of one undivided shell. The opercular valves would not completely close the aperture without the membrane which unites them.

The Coronula Balænaris (Fig. 3088), is found throughout the South Seas, imbedded in the skin and fat of whales, of which animals it must be a great tormentor. We have already alluded to a specimen of Coronula Diadema, in the Museum of the Royal College of Surgeons, to which is attached a group of the Otion Cuvieri (Gymnolepas Cuvieri). For an admirable and most elaborate illustration of the anatomy of the cirrhopod of Coronula, Dr. H. Burmeister's work 'Zur Naturgeschicte der Rankenfusser' (Berlin, 1834) may be referred to by those who wish to pursue the subject.

Ranzani has founded a genus which he terms Chthalamus, and which he describes as having a very depressed shell with six pieces or valves, very thick at their base, and forming very regular rays; the aperture is tetragonal; the operculum subpyramidal. He gives as an example the Chthalamus stellatus (Fig. 3089), a native of the Mediterranean.

We may now turn to the restricted genus Balanus. The species assigned to this genus offer considerable varieties of form; all have the shell composed of six pieces, four of which are comparatively large, coalescing at the sides, and forming altogether by their junction a rude hollow cone, having its apertures closed by an operculum of four valves, and at its base a testaceous plate.

The genus Balanus is widely spread; groups of different species are found covering rocks, floating wood, shells of various kinds, those even of the pedunculated bernicle, the armour-like investment of lobsters and crabs; any objects, in short, which will afford them a sure resting-place.

As an example of this genus we select the Balanus Psittacus (Lepas Psittacus, Molina) as an example, Fig. 3090. This gigantic species is a native of various parts of the coast of South America, and is described by Captain Philip Parker King, R.N., in his account of the mollusks, &c., collected by the officers of H.M.S. Adventure and Beagle, employed between the years 1826 and 1830 in surveying the south coast of America. "This cirrhiped," he says, "which at Concepcion de Chile is frequently of a larger size than five inches and a half long, and three inches and a half in diameter, forms a very common and highly esteemed food of the natives, by whom it is called Pico, from the acuminated process of the two posterior valves. The anterior and posterior opercular valves when in contact present some resemblance to a parrot's beak, whence Molina's name (Psittacus). It is also found very abundantly at Valdivia and to Calbuco, near the north of the island of Chiloe. It occurs in large bunches, and presents something of a cactus-like appearance. The parent is covered by its progeny, so that large bunches are found composed of from fifty to a hundred individuals, each of which becomes in its turn the foundation of another colony. One specimen, in the possession of my friend W. J. Broderip, Esq., consists of a numerous group based on two large individuals. They were collected by being chopped off with a hatchet. At Concepcion, where they were found of a larger size than to the southward, they are principally procured at the island of Quiriquina, which lies across the entrance of the bay, whence they are exported in large quantities to Valparaiso and Santiago de Chile, where they are considered as a great delicacy, and, indeed, with some justice, for the flesh equals in delicacy and richness that of the crab, which, when boiled and eaten cold, it very much resembles."

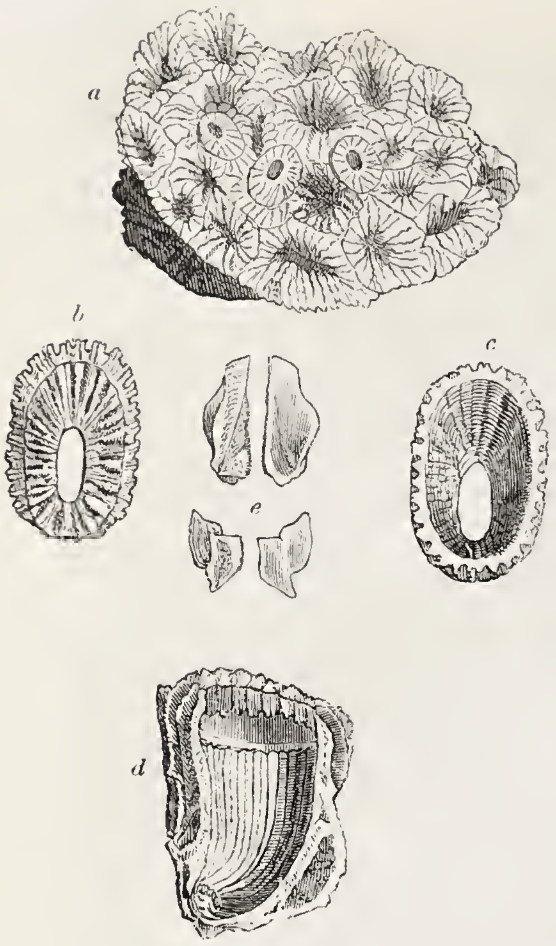
Referring to Fig. 3090, *a* represents the Balanus Psittacus, about one fourth of the natural size; *b*, the opercular valves of the natural size; the spiked terminations of the posterior valves are very decided. It is from the fissure between the two anterior valves, and which is capable of being opened by the action of certain muscles, that the plumose cirrhi emerge, and the spines seem as if intended to protect them. A fine group of the shells of this species, clustered one upon another, forms a most picturesque object.

From the genus Balanus Dr. Leach separated certain small species which habitually live imbedded in sponges, and placed them in a distinct genus under the title of Acasta. Of this the Acasta Montagui (Fig. 3091) is an example. Two varieties are known, one quite plain with a flat base, the other furnished with spines, and with a convex base; *a* represents the spinious variety; *b*, the smooth variety.

The validity of Acasta is not admitted by Mr. Sowerby, who restores the species to the genus Balanus.

A genus termed Catophragmus by Mr. Sowerby has been founded by that naturalist for the reception of some singular species with a bivalve operculum, and a shell composed of eight unequal pieces, forming a subconical tube. A remarkable peculiarity, with respect to the shells of Catophragmus, consists, says Mr. Sowerby, "in a number of narrow perpendicular valves, arranged round the shelly cone, and in rows like pales, the first row of which consists of eight pieces, placed so as exactly to cover the sutures of the shelly cone, immediately surrounding the animal; around this are then placed several sets of more and more numerous pieces, gradually decreasing in size, so that the outer row, which is the most numerous, consists also of the smallest pieces. Additional rows seem to be produced as the animal increases in age, for a young specimen in our possession has only one row of eight pieces covering the sutures of the first cone, while a much larger and older specimen still retains part of three rows, and has evidently lost some of the external rows. The young individual also shows that the whole of the pieces are pointed at their superior extremities, whereas in the old shells these extremities are so worn or eroded as to become very irregular and obtuse."

As an example of this genus we give the Catophragmus imbricatus, Sowerby, Fig. 3092. It is a native of the seas around the West India Islands: *a* represents the old shell of this species of the natural size; *b*, the same magnified, showing the rows of perpendicular appendages to the shelly

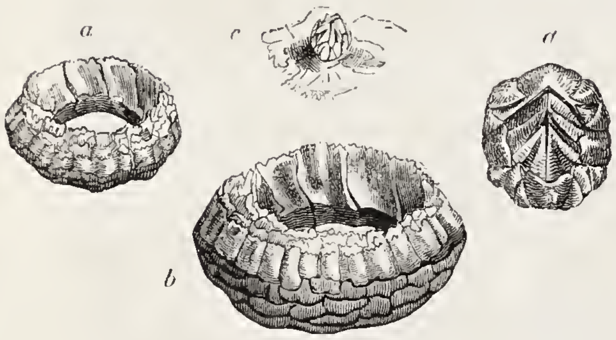


3083.—Pyrgoma crenatum.

3087.—Tubicinella Balænarum.

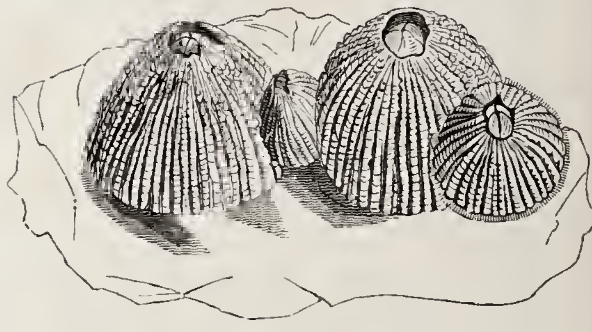
3093.—Octomeris angulosa.

3089.—Chthalamus stellatus.



3092.—Catophragmus imbricatus.

3091.—Balanus Montagui.

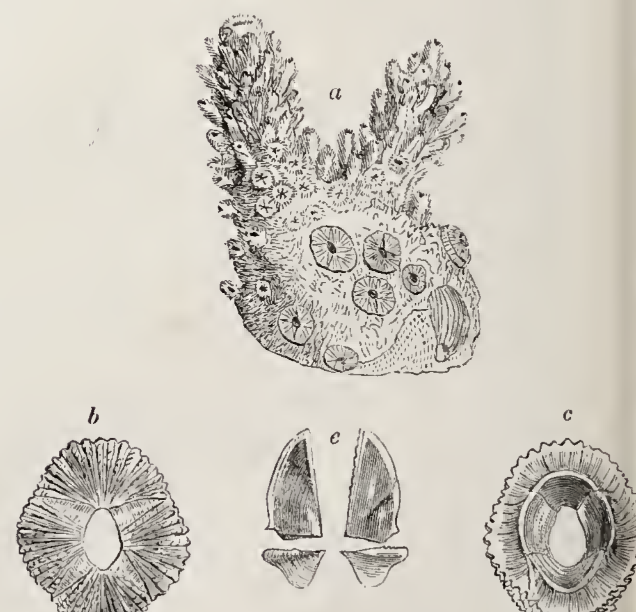


3086.—Conia porosa.

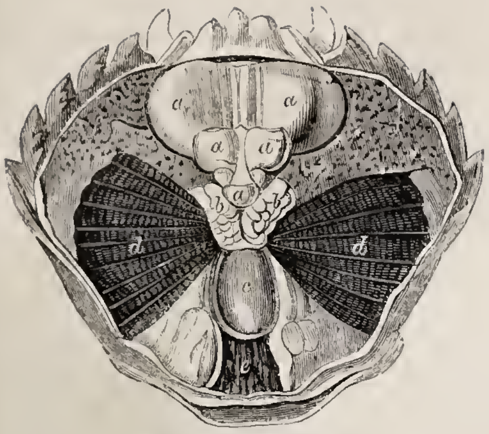
3084.—Clitia verruca.

3090.—Balanus Psittacus.

3088.—Coronula Balænaris.



3085.—Creusa gregaria.

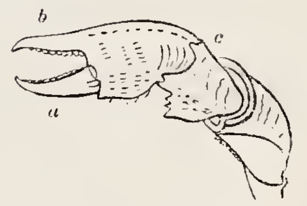


3094.—Carcinus mænas, open.

3097.—Carapace of Astacus fluviatilis.

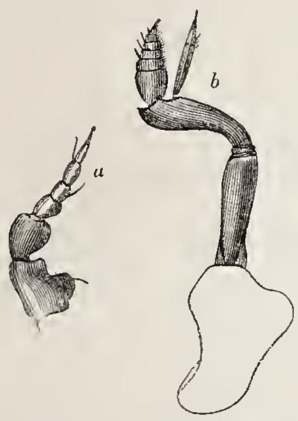
3096.—Carapace of Carcinus mænas.

3095.—Astacus fluviatilis, open.

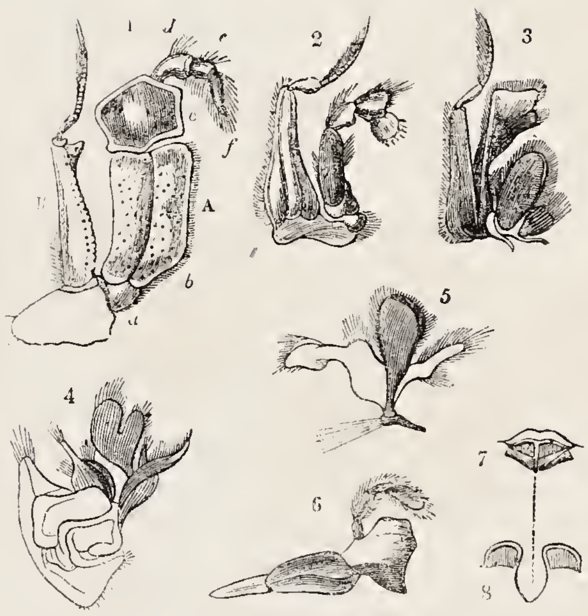


3101.—Claw of Thelphusa fluviatilis.

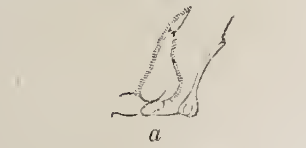
3102.—Posterior Foot of Thelphusa fluviatilis.



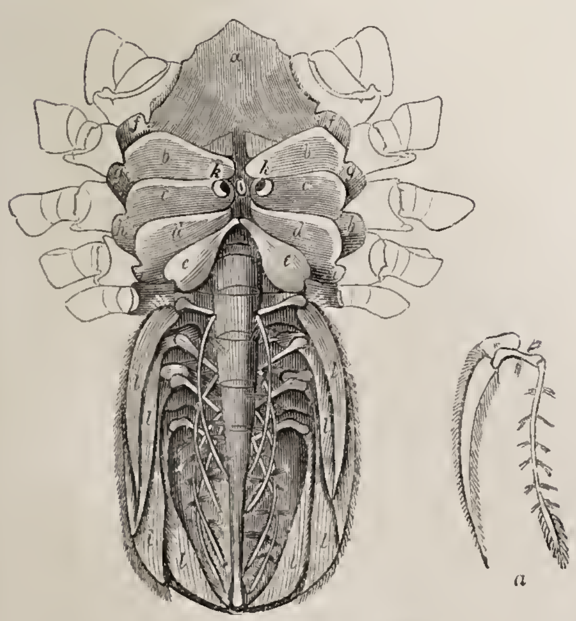
3103.—Antennæ of Thelphusa fluviatilis.



3100.—Jaw-feet of Thelphusa fluviatilis



3099.—Under side of Male Crab.



3098.—Under side of Female Crab.

3104.—Crab-fishing.

cone, and of which a triple series is seen; *c* is the young shell of the natural size adhering to a portion of rock; *d* is the same magnified, and placed in such a position as to show the operculum, and the pointed ends of the additional pieces with which the shelly cone is first strengthened, before an additional layer is added or the points have become eroded.

Another and very curious genus established by Mr. Sowerby is Octomeris. The cone consists of eight pieces, their sutures internally exhibiting an angular configuration; the shelly pieces are externally foliaceous; there is no internal plate; a thin epidermis is observable; the operculum consists of four parts. As an example, we give Octomeris angulosa, Sowerby, Fig. 3093: *a* represents the shell in such a position as to show the operculum and the eight foliated pieces of the cone; *c, d, e, f, g, h, i, k*, represent the eight pieces separated and presenting their internal surface: *c*, the anterior piece; *d*, the posterior piece; *l*, the operculum, consisting of four pieces, of which the two anterior are the largest.

With respect to fossil specimens of the shells of the Cirrhopoda, they appear to be of rare occurrence, fragments of Pentalasmis from the Calcaire grossier of Grignon, and the Suffolk crag, have been met with, and fossil balani have been found in tertiary deposits, and species are recorded from the beds of Piacenza, Bordeaux, Paris, Essex, &c. Here, then, we terminate our sketch of the Cirrhopoda, which, enclosed as they are in shelly cases, few, we think, will consider as immediately allied to the bivalve testacea. Their symmetrical limbs and nervous system are distinguishing characteristics of great importance; and with respect to the shell and mantle, which, if analogous to the same parts that envelope the mollusks, would certainly determine an approximation between the two groups: even these parts, according to Professor Burmeister, are essentially different, and bear more resemblance to the external covering of the crustacea than that of the mollusca.

We may here also revert again to the singular transformations which the young of the Cirrhopodi undergo after exclusion from the egg, and of which, if the observations of Cavolini, of Mr. Thompson, and Professor Burmeister be verified, some of the crustacea, as the common crab, also afford examples. The changes of the young cirrhopods from a state of freedom, and from a comparatively perfect organization, with eyes and limbs adapted for swimming, to a fixed condition, and to a modification of structure destitute of organs of sight and locomotion, is indeed very surprising. Startling as the fact may be, there is no reason to doubt the correctness of Mr. Thompson's statements. It must then be concluded that on entering into life the little creatures are free agents, and possessed both of that peculiar instinctive impulse which urges them to seek a place of permanent rest, and of that instinctive knowledge which enables them to determine upon that suited to their specific habits. Hence then does each species select its proper abode, the coral mass, the sponge, the log of wood, the rock or stone, or the skin of the whale, the shell of the tortoise, or the valves of mollusks reposing at the bottom of the sea. Having once fixed upon their resting-place, and there settled, the transformation begins, and the once active cirrhopod is moored or fastened closely throughout its future term of existence; to this new mode of life is its novel organization adapted; its cirrhi enable it to prey on the minute tenants of the water; its shell defends it; it grows rapidly, and fulfils the part allotted to it in the grand scheme of creation.

ARTICULATA, CUV. (HOMOGANGLIATA, OWEN).

THE term Homogangliata, proposed by Professor Owen as the designation of this great group or subkingdom, alludes to the condition of the nervous system,—the term Articulata to external conformation, the body being composed of a series of rings formed by the skin or integument, which may be soft as in the worm and leech, or hard and serving as an external skeleton, as in the beetle, the crab, and the lobster.

With respect to the nervous system, it consists of a series of ganglions symmetrically disposed along the ventral region of the body united by intervening nervous filaments so as to form a continuous chain. The first, or anterior pair of ganglia are an exception, as far as position is concerned, to the rest, being placed on the dorsal aspect of the body; they give off a nervous ring which embraces the œsophagus, and communicates with the succeeding ganglia. These œsophageal ganglia also give off nervous filaments to the head, the organs of vision, hearing, taste, &c., and being in some degree devoted to the perceptive faculties, have been regarded as analogous to the brain in the higher orders. The other ganglia in succession give nerves to the respective segments of the body to which they belong. In the higher crustacea the œsophageal ganglia are consolidated into one, and in numerous instances certain of the succeeding ganglia become blended into single ones, so as to form a few concentrated nervous centres.

As may be inferred from the arrangement of the nervous system, the body in the Homogangliata is symmetrical. Where limbs exist we find them disposed in equal order and number on each side; and there are distinct sanguiferous and respiratory systems. Among the Homogangliata the various groups or classes differ much from each other in form and characters; in habits and modes of life. Some are aquatic, some terrestrial, and every mode of progression from crawling to swimming and flying is exhibited among them.

We have said that the framework of the Homogangliata, or Articulata, consists of a series of rings of greater or less density either composing the integuments themselves or else added to them, and constituting a kind of external skeleton, both for the attachment of muscles and the protection of the internal parts.

In the lowest groups the rings are soft and numerous, and the body is elongated; these beings, such as the leech, worm, &c., have no true limbs, though appendages of use in progression are allotted to the various segments. In the higher groups the limbs are well developed, and in one class we find wings.

CLASS CRUSTACEA

(CRABS, LOBSTERS, &c.). The Crustacea are all, or almost all, aquatic in their habits, and have their organs of respiration modified for the element they naturally tenant. In their bodily conformation they do not depart from the annulose model, though the rings in the higher groups of the class coalesce to a greater or less extent, accompanied by an according concentration of the nervous system. In the lower groups, indeed, the annulose conformation is maintained, as in the Myriapods (Centipedes, &c.), and each segment has its limb subservient to locomotion. If with Latreille, Lamarck, and others, we place the Woodlice (Oniscus, Porcellio, and Armadillo) within the pale of the Crustacea, we have in them a link immediately in connection with the Myriapods, whence through the Ligia oceanica, or marine oniscus, and other allied genera, we advance to the genus Cyamus (subgenus Leptomera), and then pass on to the Sandhoppers, as Talitrus, Gammarus, &c., and then to Squilla, Lucifer, &c., and so on to the Shrimps (Crangon), the Prawns (Palœmon), the Lobsters, and the Crabs.

It is in these last that the greatest centralization of the system presents itself, the rings being soldered into a single carapace covering the anterior part of the body, and the nervous ganglia equally coalescing.

The Crustacea are invested either with a horny tegumentary covering, as in the shrimp, or with a mail of considerable hardness, composed of carbonate of lime, as in the lobster and crab. This armour is, indeed, an external articulated skeleton, secreted by a vascular dermis or skin, and is at intervals thrown off and renewed.

We may here observe that in Latreille's arrangement the Crustacea primarily resolve themselves into two great sections, the Malacostraca* (soft-shelled animals) and Entomostraca (shelled insects). It is to the first section that we shall at present confine our attention.

The modes in which the Crustacea have been classified are almost as various as the writers who have made this department of zoology their study. That of Milne Edwards is that to which preference is to be given. It does not differ in material points from the simplified table subjoined.

MALACOSTRACA.

Eyes on peduncles, and moveable.

Orders.

Decapoda
- Brachyura—as Crabs.
- Anomura†—as Hermit Crabs, Birgus, &c.
- Macrura—as Lobsters.

Stomapoda
- Unipeltata—as Squilla.
- Bipeltata—as Phyllosoma, Lucifer, &c.

Eyes sessile and immoveable.

Amphipoda—as Gammarus, Talitrus, &c.
Læmodipoda—as Cyamus, Leptomera, &c.
Isopoda—as Ligia, Limnoria, Canolira, Oniscus, Armadillo.

In order to understand the general structure as it obtains in the higher Malacostraca, let us take a familiar species, the Common Lobster, and attentively examine its organization. In the first place, then, we observe that the head and thorax are, as it were, blended into one piece, and covered by a dorsal shield or carapace, furrowed where the division between the head and thorax extends. To this portion, called Cephalothorax, succeeds an abdominal portion covered with seven rings of armour, broad above, capable of motion, hinged upon each other, and regularly overlapping each other's edges in succession. Of these the last may be regarded as the caudal or tail-ring; it has two oar-like plates on each side, of which the outermost is transversely jointed. We may here observe that Audouin and Milne Edwards consider the Cephalothorax to consist essentially of fourteen rings, viz., seven for the head, and seven for the thorax, so that with those of the abdomen there are twenty-one altogether.

The limbs are divided into three sets; on each side of the mouth are six limbs, termed jaw-feet (pieds-mâchoires), which are furnished with tentacular appendages. These limbs manipulate the food, turn it about, and apply it to the powerful jaws. Under the chest are based five pairs of true limbs. Of these the first pair are remarkably developed, possessing vast power, and the last joint presents us with pincers or chelæ, acted upon by voluminous muscles. In some Crustacea the chelæ are the same, but in the lobster they differ: the left pincer has its opposing edges finely dentated, and is used for seizing, cutting, or rending prey. The right is bluntly tuberculated, and is adapted for holding anchor-like upon any fixed object in order to moor its possessor amidst the agitated waters. Of the four succeeding limbs on each side the two first end in small pincers, the rest in pointed articulators. Along the under surface of the abdomen (often called the tail, but erroneously) are certain articulated appendages, termed false feet: there are five pairs, and all, excepting the first pair, which are simple, are bifid at the last joint. These false feet are not used in locomotion, but are of service in the case of the female in enabling her to affix the roe or eggs to the under surface of the abdomen. Anteriorly the carapace projects in the form of a dentated spine, protecting the eyes, two in number, placed on short moveable footstalks or peduncles. Below the eyes are four antennæ, of which the central pair are the shortest and slenderest, and they are also bifid.

In ascending the scale of beings from the lowest grades of life to the highest, the crustacea are the first in the scale to present us with definite organs of hearing; for though insects hear, the organs themselves have not been detected, though, most probably, they reside at the base of the antennæ. In the lobster they are placed on the basal joint of the larger pair of antennæ underneath, and appear in the form of a minute tympanic membrane, surrounded by a slightly elevated margin. This membrane covers a little cell filled with fluid, and a minute branch of the nerve supplying the antennæ ramifies upon it.

The mouth of the lobster is very complicated; it is furnished with two mandibles, two powerful maxillæ, and two maxillary palpi. The shell forms a labium, or sort of upper lip, but there is no distinct labium, or lower lip.

In the Macrura, of which the lobster is an example, the abdominal portion is the great organ of locomotion; hence the muscular development which it displays. It is by striking the water with a vigorous flap that the lobster propels itself along; and the caudal paddles are so arranged that when the tail is extended they slide over each other so as to present the least possible surface to the water, but during the stroke they expand. In accordance with

* Malacostraca, from *μαλακος*, soft, *οστρακον*, a shell. The name, alluding to the softness of the shell compared with that of a bivalve or univalve mollusk, is not, it must be confessed, very happily chosen. It is, however, very generally adopted.

† Macrura and Anomura are generally spelled Macroura and Anomoura, and if so, Brachyura ought to be Brachyoura.

the blow of the tail which is made towards the thorax, the lobster makes a backward progression, and such is the vigour displayed, that by a single sweep of the tail the lobster will dart back instantaneously to a distance of eighteen or twenty feet.

In the Crustacea generally the digestive organs are simple. In the lobster the gullet leads directly to the stomach, which is of considerable size: its pyloric portion is supported by strong calcareous pieces, and is further furnished with three hard grinding teeth, moved by powerful muscles, the whole constituting an efficient apparatus for bruising. This apparatus is popularly known as "the lady in the lobster." The alimentary canal is very simple. The liver consists of two large masses enclosing the pylorus, and is composed of agglomerated clusters of minute sacculi.

We may here notice the organs of respiration. Connected with the base of the jaw-feet and of the true feet, is a series of pyramidal tufts, consisting each of a stem covered with vascular filaments. These tufts or gills are shrouded beneath the carapace on each side, and fill a sort of shallow chamber lined with a fine membrane. Each chamber freely admits the water by a wide fissure, while an orifice near the mouth permits its egress; this latter orifice is closed by a semi-membranous flap (flabellum) continued from the second of the jaw-feet, and so arranged that every motion of the jaw-feet tends to create a circulation of the water imbibed. The movements of the true limbs also add to this circulation, and maintain a due current over the branchial surfaces. The stems of the branchial plumes enclose each an artery and a vein.

With respect to the circulation, we find a heart of an oval shape below the plate of the thorax near its margin; it consists of a single cavity with strong muscular walls, and gives off several main arteries, which ramify over different parts. Of these main trunks one goes to the stomach, antennæ, eyes, and mouth, another is ramified over the lobes of the liver; a posterior vessel supplies the great muscles of the tail, while a thoracic vessel, directed downwards, sends a branch anteriorly, supplying the limbs, jaw-feet, and the branchiæ, and another branch posteriorly supplying the false limbs. The blood returns from every part by a system of veins, which merge into a series of extensive but very shallow reservoirs along the dorsal region. The largest occupies the thoracic part, and communicates with the heart by several short trunks, guarded at their entrance by valves. The blood poured into the heart is of two kinds, viz., purely venous, and renovated or arterial blood from the branchiæ, hence the blood sent through the arteries of the system generally is of a mixed character.

It must be observed, however, that Milne Edwards and Audouin regard the heart as purely systemic, and the reservoirs as the sole recipients of the venous blood, which, without passing through the heart, is transmitted at once to the branchiæ, and thence returned purified to the heart by a series of vessels. It is, however, fully established that though the venous reservoirs send a portion of their blood to the branchiæ for renovation, they also send a portion through four valvular orifices to the heart, the valves being so constructed as to prevent its reflux during the action of the latter. The nervous system in the lobster, as in the other crustacea, is ganglionic. We have already alluded to the different degrees of ganglionic centralization exhibited by the crustaceous groups in accordance with their development of external organization. In the crab, for example, the abdominal and thoracic ganglia become compacted into one great central mass, from which nerves radiate to the limbs and various organs. This increase of centralization is not only exhibited by the progressive series of forms as they ascend the scale of development, but by the individuals of the highest grade as they advance from an immature to a perfect condition. For example, in the river crayfish (Astacus fluviatilis), there are at first eleven distinct pairs of ganglia; in a short time the first six pairs unite, forming six single masses; afterwards the four anterior ganglia consolidate into one mass, and the fifth and sixth unite to form another mass, while the other pairs continue distinct. It has been suspected that in insects the nerves are of two kinds, viz., nerves of motion and nerves of sensation; and this condition of the nervous system has been found by Mr. Newport to obtain in the Crustacea. Yet we need not thence infer any high degree of susceptibility, for there is still no brain, unless, indeed, we give this term to the œsophageal ganglia, which, no doubt, they merit to a certain extent. Yet we may spare half our pity for crabs, lobsters, and shrimps while boiling, and bestow that half upon the over-worked horse, the ill-used dog, or the suffering of our own species.

There are certain circumstances connected with the growth of the Crustacea which we must not here omit to notice. Imprisoned within their armour, the necessity of frequent changes of it, in order that the body may develope in size, is imperative; for the plates of mail, when once formed, remain unaltered, and cannot be increased by subsequent additions. Strange to say, however, it is not only the shelly plates of these animals which are changed, but also the covering of the eyes, the lining membrane of the stomach, the teeth connected with it, and also the calcareo-tendinous expansions to which the muscles of the claws are attached. Released from its hard encasement the soft body suddenly pushes forth its growth, and shortly acquires a new coat of armour, to be again cast off at the due period.

Reaumur, who watched the process of exuviation in the river crayfish (Astacus fluviatilis), describes it as attended with many efforts and much struggling. "A few days previous to the commencement of the operation (early in autumn) the creature abstains from all solid nourishment; the carapace and abdominal segments will be then found to offer less than the usual resistance to the pressure of the finger. Shortly afterwards the crayfish appears restless, and rubs its legs against each other; it then throws itself on its back, agitates and distends its whole body, by which the membrane joining the carapace to the abdomen is burst, and that great dorsal plate is raised. Some degree of rest follows these first struggles, but after a short time the animal again puts all its organs in motion; the carapace is seen to rise gradually from the legs beneath, and in less than half an hour the animal has extricated itself from this portion of its slough. By retracting its head, the antennæ, eyes, and legs are withdrawn as from a case, and the extrication of the last being the most difficult and complicated operation, is attended with so much pain, that the effort sometimes occasions the loss of one or more of these organs. The hinder parts are withdrawn with less difficulty; the head is conducted below the carapace, and the abdominal plates are thrown off by a forward motion, attended by a brisk and distensive action. The creature is now seen divested of all its incumbrances, and the case is left unbroken, as if no struggle had ever taken place within it."

To this account we may add, as was found by Professor Jones, that the segments of the chelæ, but not of the ordinary legs, are split in the neighbourhood of the joints, and the articulating ligaments ruptured; the internal broad tendinous plates remain attached to the moveable joint of each pincer, and the stomach-lining with its teeth is contained within the rejected carapace.

In the prawn, shrimp, &c., the process of exuviation has not been watched; in the lobster, the circumstances as detailed by Mr. Couch ('Mag. Botany and Zool.' vol. i., p. 171), differ from those attending the exuviation of the River Crayfish. The lobster to the last is ravenous, and vigorous, and instances have been known in which, enticed by the bait, lobsters about to cast their slough have entered into the fishermen's *creels* or traps, and on the men commencing to handle their prize, the animal has slipped away, leaving its empty husk in the grasp of the astonished fisherman. "It was by a circumstance somewhat similar," says Mr. Couch, "that the opportunity is afforded me of giving a minute description of a very perfect case, left by the creature when it made its escape, for escape it did, to the no small annoyance of the fisherman, who had calculated on the possession of a prize of somewhat above the ordinary magnitude. I cannot find that any extraordinary actions or contortions have been observed in the lobster when engaged in delivering itself from its trammels, or that the time is prolonged, as in the case of the crayfish; and it is certain that when freed it possesses great activity in effecting its escape. In the specimen referred to, the cases of the antennæ and palpi were perfect to their minutest extremities; the stalk also, and the transparent covering of the eyes, were uninjured; the segments and joints of the posterior part of the body with the caudal plates were all joined together, but without any intervening membrane; and the inferior parts from beneath the snout, including the jaws, the jaw-feet, the chelæ and legs, with the sternal (breast) plate, œsophagus, and internal coat of the stomach, formed one connected portion, with no further separation than arose from the absence of every portion of membrane." The manner in which the animal escaped was not to be mistaken. "Through the middle of the carapace ran a line as straight as if it had been cut with a knife, and evidently formed by a natural process of separation, for it even proceeded through the centre of the snout, to the terminal pointed process at the root which turned off to the right side, so that the least effort by the animal was sufficient to afford it a passage."

In the common crab, according to the same observer, the exuviation takes place by a separation of the dorsal from the under part of the carapace, the animal lying on its back during the process. Previously to this event, in the crab, and, as it would appear, also in the lobster, the fleshy contents of the limb-cases, and especially of the great chelæ, shrink very considerably, wasting away to mere rudiments; were it not so, the flesh of the chelæ could not be extricated, for it does not appear that the claw-cases of the crab and lobster are fractured. "The newly extricated crab, not unlike a lump of dough enclosed in a membrane, has at first strength enough only to enable it to crawl to a place of safety, some hole or fissure. There it absorbs as much fluid as will distend its organs, and their common covering, now as flexible as velvet, to the full extent of their capacity, by which means the deposition of the calcareous crust is made according to the newly acquired bulk of the animal, which is proportionately the most increased in the youngest individuals."

In the earlier stages of life the exuviation and sudden pushing forward of growth occur several times in the course of the year, but at more and more distant intervals as the animal verges towards maturity. When the full size is attained, the shell is most probably never cast off and renewed. We have ourselves examined a large Norway lobster, in a living state, the carapace of which formed a bed upon which a multitude of full-grown mussels were firmly attached in close array, presenting a curious picture. Mr. Couch has found oysters two inches and a half in diameter adherent to the carapace of living crabs; and many specimens of crabs with oysters firmly agglutinated to their carapace are to be seen in the British Museum.

There is another curious fact in the history of the crustacea, which we must not omit to notice, namely the power they possess of reproducing their limbs when lost by accident. The loss of a leg seems to be of little importance; nay, when suddenly alarmed a lobster will frequently throw off its claws with a violent jerk, and indeed, when a limb is injured, the animal generally breaks it off, at the joint second to its junction with the trunk, where the growth of a new limb the most speedily takes place. No pain appears to attend this strange operation; the wound becomes covered with a delicate pellicle, and a new claw is in due time produced. It remains, however, unprotected by a hard shell until the next general moult, and seldom or never acquires the size of the corresponding claw, although it is perfect in all its parts.

It has been asserted by many physiologists, and among them by Cavolini, that the Decapod Crustacea undergo several metamorphoses, after exclusion from the egg before obtaining their permanent figure. Mr. Thompson in the 'Philosophical Transactions' describes the changes in the common crab, of which, according to him, the newly hatched young differs so much from the adult as to have been placed in a very distinct group of crustaceans, and described under the name of Zoea pelagica. The question, however, is by no means set at rest; Rathke, who has most elaborately traced the development of the crayfish, asserts that the Decapods, as far as he has examined their habits and economy, do not undergo the changes described by Mr. Thompson in the case of the crab, adding that "at the end of their existence in the egg, they have exactly the same aspect, and are as fully developed (except as to size) as the full-grown individuals." ('Ann. Nat. Hist.' 1837.) Mr. Westwood has dissected the eggs of the land-crab of the West Indies, and also denies the fact of any metamorphosis in that species. (See 'Phil. Trans.' 1835.)

We may now turn to our pictorial specimens illustrative of the general structure of the Crustacea. Fig. 3094 represents the Carcinus mænas, a species of crab common on our coasts, with the upper portion of the carapace removed to show the arrangement of the internal organs. *a*, *a*, *a*, *a*, the stomach; *b*, *b*, parts for a special purpose; *c*, the heart; *d*, *d*, the branchiæ; *e*, *f*, *f*, the liver.

Fig. 3095 represents the river crayfish, Astacus fluviatilis, similarly laid open. *a*, *b*, and *c*, denote the same parts as in Fig. 3094; *d*, *d*, *d*, *d*, the liver; *e*, the branchiæ; *f*, *f*, muscles of the mandibles.

Fig. 3096 is the upper surface of the carapace of Curcinus mænas; *a*, *b*, and *c*, are regions corresponding to the parts marked by the same letters in Fig. 3094; *d*, the posterior hepatic region; *e*, *e*, the branchial regions; *f*, *f*, the anterior hepatic regions.

Fig. 3097, the carapace of Astacus fluviatilis. The regions into which it is artificially divided are marked by the same letters as in Fig. 3096.

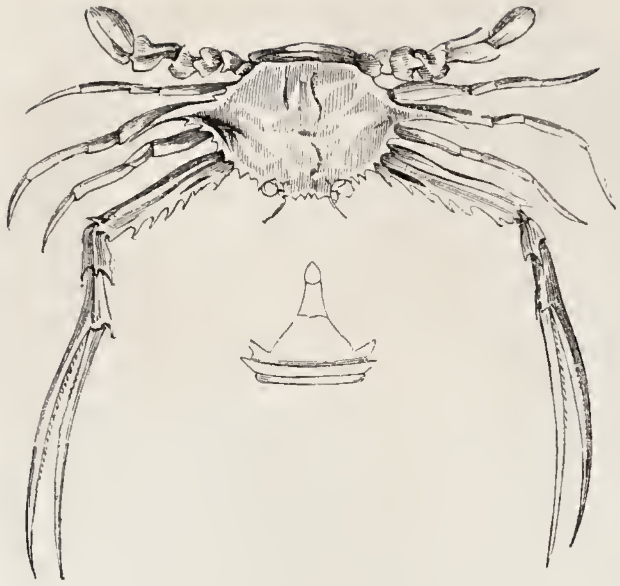
Fig. 3098, the under surface of the female crab, with the tail extended; *a*, *b*, *c*, *d*, *e*, sternal pieces; *f*, *g*, *h*, *i*, latero-sternal pieces; *k*, *k*, orifices; *l*, *l*, *l*, abdominal appendages, or false feet.

The detached figure (*a*) represents one of the false feet removed.

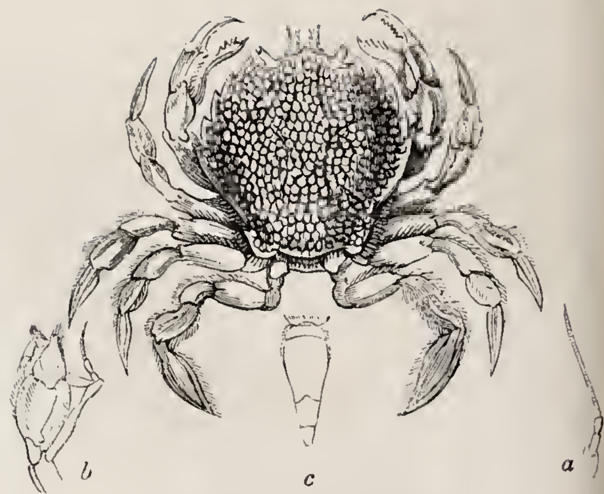
Fig. 3099, a view of the under surface of the male. The detached figure (*a*) shows one of the false feet.

Fig. 3100 represents the jaw-feet of Thelphusa

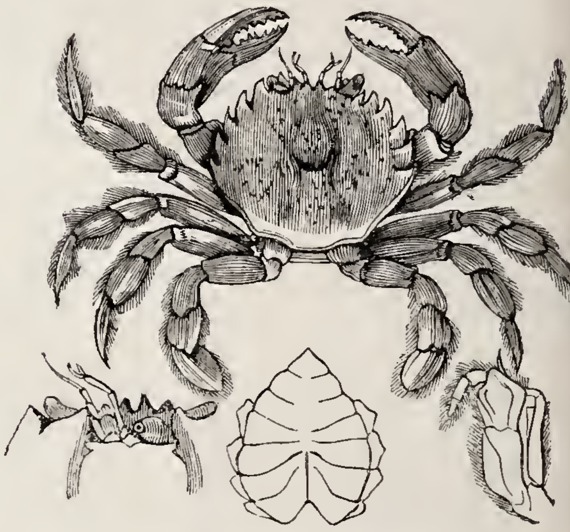
3112.—Lupea cribraria, and details.



3114.—Lupea forceps.

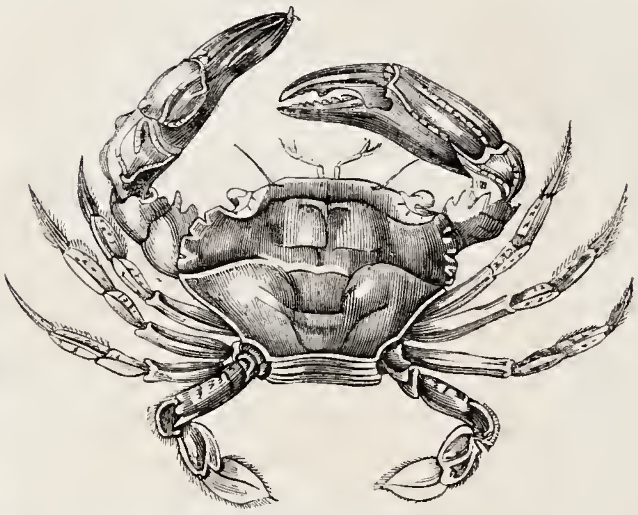


3106.—Portumnus variegatus.



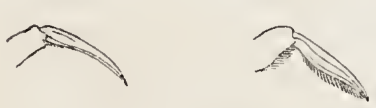
3110.—Platyonychus bipustulatus.

3113.—Lupea pelagica.



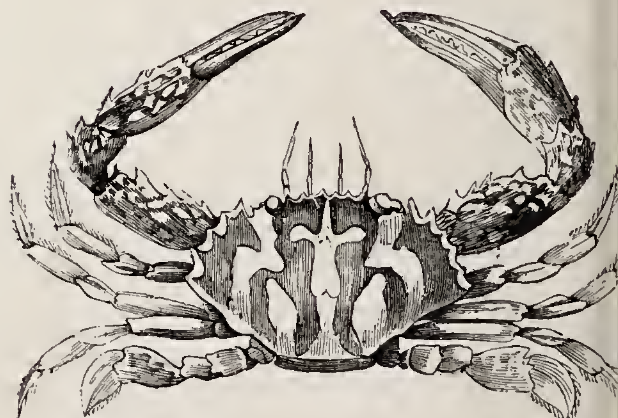
3115.—Thalamita Chaptallii.

3108.—Portunus puber.

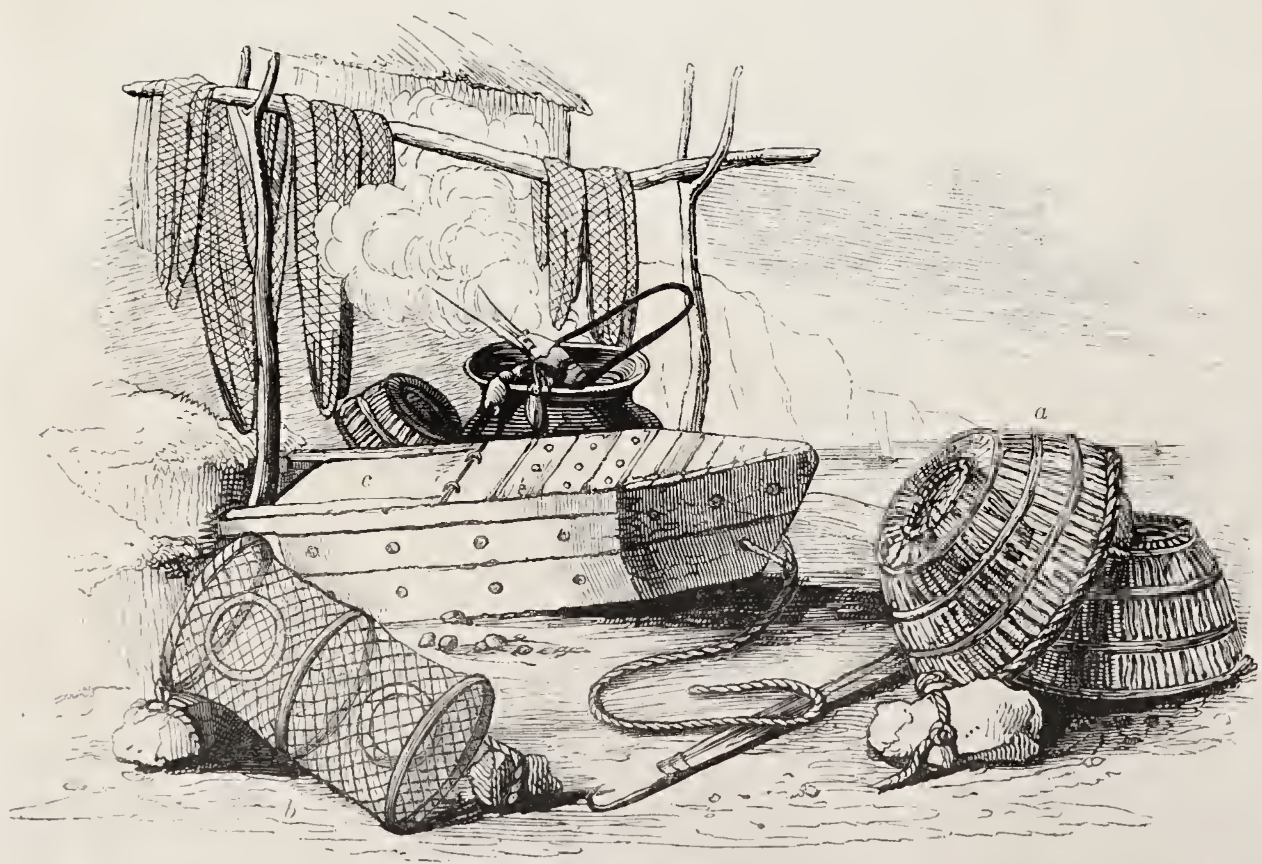


3109.—Feet of Carcinus.

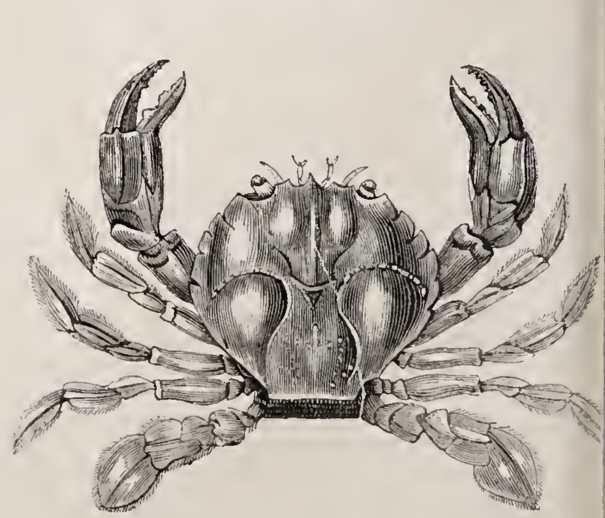
3107.—Orbits, Antennæ, and Jaw-foot of Portunus.



3116.—Thalamita crucifera.



3105.—Implements employed in Crab fishing.



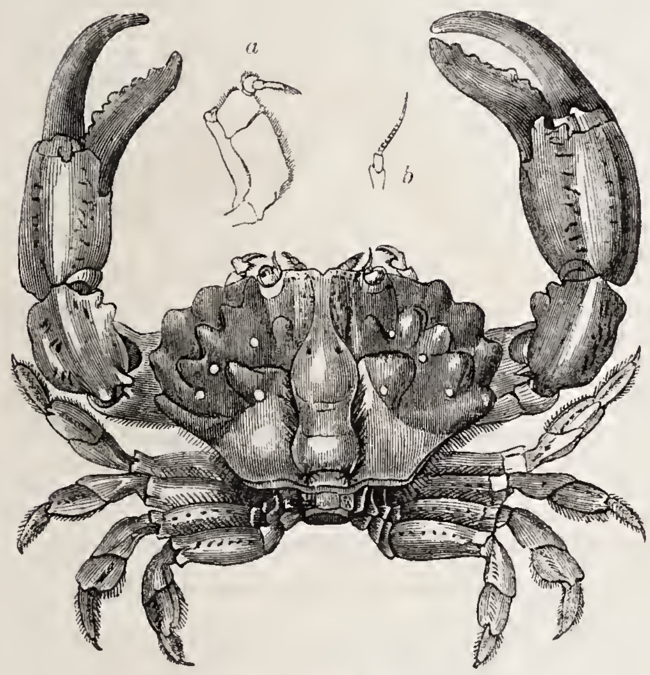
3111.—Polybius Henslowii.

3119.—Podophthalmus vigil.

3123.—Eriphia spinifrons.

3117.—Thalamita natator.

3121.—Piremela denticulata.

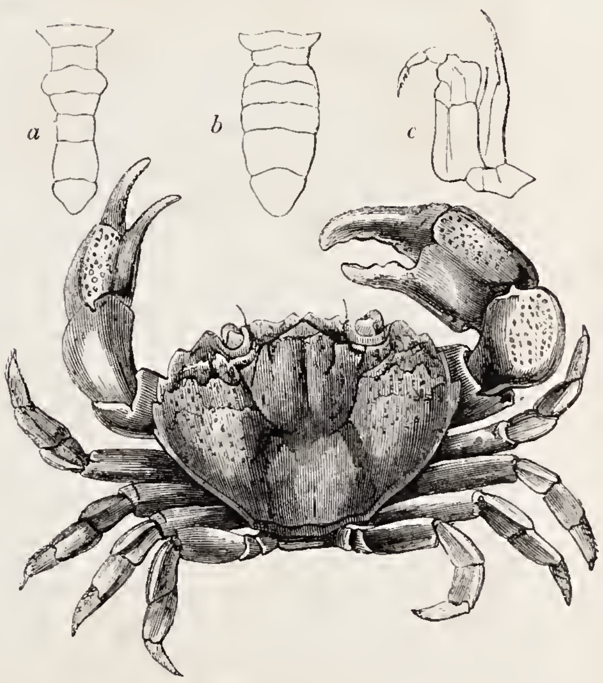


3120.—Xantho floridus.

3124.—Eriphia Gouagra.

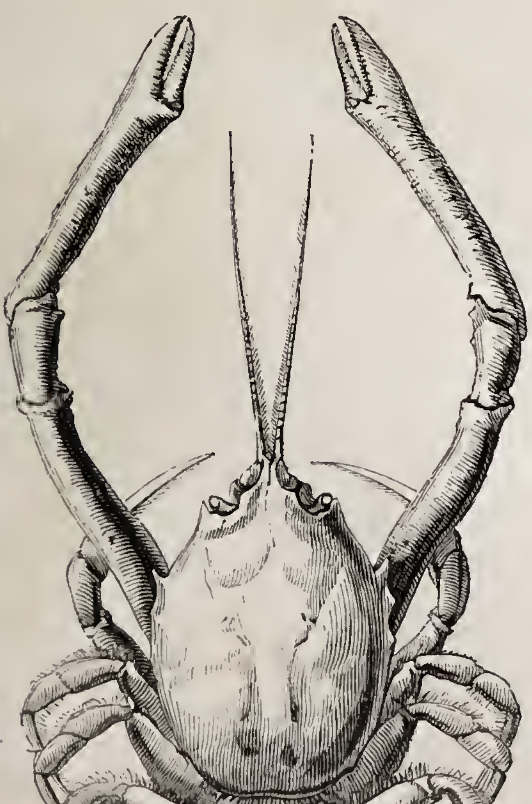
3118.—Eye, Orbit, and Jaw-foot of Podophthalmus.

3129.—Corystes Cassivelaunus: Female.



3126.—Ruppellia tenax.

3125.—Eriphia lævimana.



3128.—Corystes Cassivelaunus: Male.

3122.—Thia polita.

3127.—Zozymus æneus.

fluviatilis, a fresh water crab found in the south of Europe. 1, the right internal jaw-foot; A, its internal blade; *a, b, c, d, e, f*, its various articulations; B, its external blade, or flabelliform palp: 2, jaw of the fourth pair with its palp: 3, jaw of the third pair with its palp: 4, jaw of the second pair: 5, jaw of the first pair: 6, mandible with its palp: 7, the upper lip: 8, the tongue, a sort of horny lamellar process performing in some degree the functions of a lower lip.

Fig. 3101 the claw or chelæ of Thelphusa fluviatilis. *a*, the moveable finger opposed to the immoveable finger; *b*, of the claw; *c*, the carpus, or wrist.

Fig. 3102, the posterior foot of Thelphusa fluviatilis. *a*, the haunch; *b*, the trochanter; *c*, the thigh; *d*, the leg; *e*, the metatarsus; *f*, the tarsus.

Fig. 3103, the antennæ of Thelphusa fluviatilis. *a*, the right external antenna; *b*, the large antenna of the same side.

ORDER DECAPODA.

Branchiæ fixed to the sides of the thorax, in respiratory cavities; the oral apparatus composed of six pairs of members. True limbs five pairs.

Section Brachyura—short-tailed Decapods, as Crabs. The Brachyura, or crabs, have their form far better adapted for walking on the shore, or at the bottom of the sea, than for swimming. The cephalo-thorax is developed; the antennæ are short; the tail, or more properly the abdominal portion, is greatly reduced, and when not used is kept bent under the thorax, and lodged in a depression between the origin of the legs. The branchiæ are under the edge of the carapace in the form of broad lamellæ laid over one another, and there are three flabella on each side derived from the roots of the jaw-feet, of which two are imbedded amongst the branchiæ, while the third, in a crescentic form, extends over the whole series.

In some crabs all the feet, excepting the chelæ, end pointed, as in the common crab; but in crabs more especially adapted for swimming the hinder pair of limbs are terminated by compressed paddles, or oar-blades.

Most who have wandered along the shore of the sea at low tide have observed shoals of crabs running quickly about, in their sideway manner, and endeavouring when approached to hide themselves under stones, or bury themselves in the sand. It is, indeed, far more common for the crab thus to approach the shore than the lobster, for the former is far more terrestrial; yet both, provided the gills are kept moist, will live a long time out of their native element. Some species, indeed, are almost exclusively terrestrial, visiting the sea only at certain periods, and again returning to the land where they live in deep burrows.

The large edible crab (Cancer pagurus), Le crabe poupart, ou tourteau, of the French, is too well known to need description; it may be taken as the type of Brachyura. It is much esteemed as a delicacy for the table, but previously to moulting, and during the time in which it is destitute of its armour, its flesh is soft, watery, and very unpleasant. On the contrary, some of the crabs in the West Indies, and America, are at that season in their highest perfection. A writer in the 'American Cyclopædia' says, "Myriads of crabs are caught on the shores of the rivers and creeks of the Chesapeake Bay, when in their soft state, and sold to great advantage. The epicure who has never tasted soft crabs should hasten to Baltimore, Annapolis, or Euston in Maryland, in July and August, to make himself acquainted with one of the highest luxuries of the table."

The powers of vision, smell, and taste, are enjoyed by the crab in great perfection. With regard to smell, though, as has been well observed, every creel baited for the capture of these animals and lobsters proves them to be endowed with it, yet where the organ is seated is a matter of doubt.

The large edible crab, Cancer Pagurus, is partial to rocky coasts, and is taken around those of our island in great abundance. Crab-fishing is generally conducted by two men, who go out in one boat; in addition to their boat, they have lines, and creels, cruives, or crab-pots, as they are termed in various counties, the original cost of which amounts to about ten pounds. These creels are made of dry oziers, and resemble basket-work. They are constructed on the same principle as a wired mouse-trap, but the aperture, instead of being at the side, is at the top. Within the creel the bait, consisting of pieces of thornback, skate, or other fish, is fastened to the bottom, and the creel is then dropped in some favourable situation, three stones of sufficient weight being fastened in the inside to sink it. The creels are sometimes let down to a depth of twenty fathoms, the fishermen being guided in this respect by the state of the weather, or the nature of the ground. In fine weather they are dropped in from three to five fathoms deep: but the crabs are chiefly to be found where the bottom is rocky. A line is fastened to the creel, and at the upper end of the line a cork is attached which floats on the surface. By this means the place where the creel is sunk is known to the fishermen, who usually set from forty to fifty creels at one time. The bait is suspended about the middle of the creel, and can easily be seen by the crabs, which, entering at the aperture, find, like a mouse in a wire trap, that escape is impossible. The difficulty of egress is increased by the entrance being overhead. Lobsters, prawns, and shrimps are frequently found captured in the same creel with crabs. When the fishermen have sunk the whole of their creels, they have still some time left to proceed farther out to sea for other fish before it is necessary to visit them. Crab-fishing is is therefore a valuable addition to their means of livelihood, for it does not preclude the pursuit of other fish at the same season. The demand for this species of shell-fish is usually good. and in the nearest large town on many parts of the coast it is often fully equal to the supply. Thither the fisherman's wife or some of his family may convey the quantity taken; and, if the market be already abundantly provided, they can by means of the well-boxes, although already caught, be kept back for a time until prices rise again. These are all advantages peculiar to this fishery. When a few hours have elapsed, the fishermen visit their creels, one of them rowing and the other keeping a look-out for the floats, and taking out of the creels whatever has been captured. There may perhaps be a dozen different owners of boats thus engaged, and it is therefore necessary to have recourse to some means by which they may each secure the fruits of their individual industry without the risk of dispute. This is accomplished by distinguishing their respective floats by some peculiar mark—by a notch in the side—a mark in the shape of a diamond cut at the top—an angle cut off, &c. &c. The necessity of mutual protection points out to them the value of combination and union, and the marks adopted by the fishermen to distinguish their floats are consequently the result of some common understanding amongst them; or otherwise, of an instinctive regard to the means by which not only one but all are enabled to pursue their calling in confidence and security.

Crabs are brought to market both in a boiled and in a raw state. If the market be distant they are placed in a well-box, which is attached to the outside of the fishing-vessel, and in this manner they are brought to Billingsgate from parts so distant as Norway. May, June, and July are the months in which they are generally out of season; but even in these months many may be obtained which are in a perfectly good state for the table. The male is of greater value than the female, and has larger claws. The sexes are distinguished as the cock and the hen. Before boiling, a good crab is known by the roughness of its shell, particularly on the claws. When boiled, the mode of ascertaining its goodness is by holding the claws tight, and shaking the body, which will rattle, or seem as if water were in the inside, if it be not in perfection. The time they are usually boiled is from a quarter of an hour to a couple of hours in sea-water, or in water in which salt has been infused. Sometimes they are put into cold water, which is afterwards heated to the boiling point; and this mode is believed to be less cruel than plunging them suddenly into water heated to a high temperature, though it is alleged they are inferior for the table when the former method is employed.

Fig. 3104 represents a scene which may be often contemplated on different parts of our coast, fishermen hauling up their creels for examination. Fig. 3105 gives a good idea of the implements used in the crab and lobster fishery. *a*, creels or crab-pots; *b*, a lobster-pot, of cordage or netting on hoops; *c*, a well-box, for preserving the animals.

We shall now pass to a review of our pictorial specimens; stopping only to notice those species to whose history a more than ordinary interest is attached.

Fig. 3106, Portumnus variegatus. This species, one of the paddling crabs, is closely allied to the Carcinus mænas of our coasts; but has the posterior limbs still more paddle-formed. It is a native of the Adriatic, and the Mediterranean. *a*, the external antenna; *b*, the external jaw-foot; *c*, the tail or abdomen.

Belonging to the same natural group are several genera, as Portunus, of which the orbits, antennæ, and jaw-foot, are represented at Fig. 3107; and one of the species, Portunus puber, at Fig. 3108. This species, the Cancer velutinus of Pennant, is about two inches and a half long; and is found on the coasts of England and the adjacent Continent. It is the Crâbe à laine, the Crâbe espagnol and l'etrille of the French. Its flesh is accounted very delicate. Its posterior limbs may be compared with those of Carcinus mænas. Fig. 3109, the Carcinus mænas (rect of), le Crâbe enragé, or small common crab, is extremely common on our coasts and those of France. It may be seen at low water running on the shore, with great rapidity; and when approached it buries itself in the sand. Though not much esteemed this crab is eaten both in London and Paris. We have seen baskets-full hawked about the streets of our metropolis and the suburbs.

Another allied form is the genus Platyonychus, of which the P. bipustulatus, Fig. 3110, is an example. It is of moderate size, and inhabits the Indian Seas. We may here notice the genus Polybius, in which all the feet, excepting the chelæ, are formed for swimming; the posterior pair are short and broad. A small species, Polybius Henslowii, Fig. 3111, is found in the British Channel, but generally keeps at a distance from shore.

Among the more exclusively marine genera is that termed Lupea. The species are seen in the open ocean, swimming with great address near the surface, where, as Bosc remarked, these crabs have the power of suspending themselves motionless, in a state of repose. They haunt masses of drifting sea-weeds, and there find both a retreat and food. The carapace is remarkable for its transverse extent, and for the strong serration of its anterior margin. The anterior limbs, which are robust, are more or less armed with spines. The Lupea cribraria, Fig. 3112, is of small size, attaining to the length of three inches. It inhabits the seas of Asia. Its colour is yellowish with numerous whitish spots.

The Lupea pelagica (Portunus pelagicus, Fabr.), Fig. 3113, is remarkable for the length of the last lateral spines of the carapace. It is an active swimmer, inhabiting the Red Sea, and the whole of the Indian Ocean.

Still more remarkable is the Lupea forceps (Fig. 3114), a small crab from the seas of the Antilles. Its last lateral spine on each side is considerably elongated, and the fore claws are produced into slender and very long pincers, so that the anterior pair of limbs far exceed the four succeeding pairs.

Among the Swimming Crabs we may notice the genus Thalamita, in which, from the width of the frame-work of the mouth, the eyes are thrown greatly apart, and the third joint of the last pair of limbs is elongated, and has a spine at the extremity of its anterior border. These points are peculiarly manifest in Thalamita Chaptallii (Portunus Chaptallii, Aud.), Fig. 3115; in which species the anterior margin of the carapace between the eyes is smooth. It is a native of the Red Sea, is not more than an inch in length.

In the Indian Ocean is found a very pretty species, the Thalamita crucifera, Fig. 3116; the border of the carapace between the eyes is dentilated, and on each side below the eyes are six serrations. Its general colour is reddish, with yellow bands and markings, a median mark on the carapace resembling a cross in figure. It is the Portunus cruciferus of Fabricius.

Another species, Thalamita natator (Portunus sanguinolentus, Bos), Fig. 3117, has the anterior limbs not only very spinous, but also studded with tubercles and the anterior margin of the carapace is serrated. It is a native of the Indian Ocean.

Among these genera of swimming-crabs, one of the most singular is that termed Podophthalmus; the eyes, which are placed upon short peduncles in the previous genera, are in this seated at the end of long moveable foot-stalks; these are inserted near the median line of the anterior edge of the carapace, and consist of two portions, the first very long, the second very short; whereas in the Ocypodian crabs, which also have footstalks of the eyes long, it is on the development of the second piece, and not of the first, that their length depends. These footstalks can be received for safety each into a long deep gutter, on the anterior border of the carapace. The antennæ are below the ocular footstalks. Fig. 3118 represents one of the eyes, peduncles, and jaw-feet of Podophthalmus. The only species, we believe, hitherto known is the Podophthalmus vigil (Portunus vigil, Fabr.), Fig. 3119, a native of the Indian Ocean. It is from two to four inches in length.

We may now pass to those genera composing what Cuvier calls Les Crabes proprement dits, of which the Cancer Pagurus is an example. He remarks that the third articulation of the outermost jaw-feet is notched or marked with a sinus near the internal extremity, and is almost square. The antennæ are short or moderate. Close to the genus Cancer he places the genus Xantho, in which the antennæ are inserted into the internal angle of the ocular cavities, and not outside, as in the former. Fig. 3120 represents the Xantho floridus, common on our coasts and those of France. *a*, the external jaw-foot; *b*, external antennæ. This is a small species, about two inches in length, of a reddish brown colour, with black claws.

In some respects the genus Piremela agrees with Xantho, but the external antennæ are prolonged, and the stem is many jointed. The Piremela denticulata, Fig. 3121, about half an inch in length, and of a greenish colour, inhabits our coasts and those of France, and Southern Europe. The carapace is strongly bossed above.

Another genus not very remote from Piremela is Thia, of which one species, Thia polita, Fig. 3122, is European. It lives buried in the sand at a small distance from the shore, and is scarcely an inch in length. Its colour is roseate.

We may here notice the genus Eriphia; in this form the lateral antennæ are inserted between the ocular pits, and the median antennæ.

One species, Eriphia spinifrons, Fig. 3123, is very extensively spread, and occurs on the coasts of Europe. Another species, Eriphia Gonagra, Fig. 3124, is a native of the coasts of South America. A third species, Eriphia lævimana, Fig. 3125, is a native of the shores of the Isle of France.

Close to Xantho may be placed the genus Ruppellia, of which one species, Ruppellia tenax, Fig. 3126, is a native of the Red Sea. It is about two inches in length.

According to Milne Edwards, between Cancer and Xantho may stand the genus Zozymus, of which the Zozymus æneus of the Indian Ocean, Fig. 3127, is an example. This species is about three inches in length, and of a yellowish colour spotted with red.

There is a very remarkable genus of crabs termed Corystes, in which the exterior antennæ are longer than the body, and furnished with two rows of cilia. The anterior limbs in the male are twice as long as the body, and nearly cylindrical; in the female they are about as long as the body, and compressed, especially at the last joint; the other feet are terminated by an elongated claw pointed and channelled longitudinally. The carapace is oval, with an anterior rostrum.

The Corystes Cassivelaunus (C. dentatus and C. longimanus, Latr.; Cancer Cassivelaunus, Pennant), is found on the coasts of England and France. The specimens figured by Pennant were dredged up near Holyhead and Red Wharf, Anglesey, in deep water. Fig. 3128 is the male, Fig. 3129 the female, of this singular crab. The surface of the carapace is somewhat granulous, with two denticles between the eyes, and three sharp points on each side.

Latreille gave the name of Melia to a form of Cancerians of which the Melia tesselata is an example. This species, Fig. 3130, is about half an inch in length, and of a whitish colour, with red lines. It is found on the shores of the Isle of France.

We now pass to the genus Etisus of Milne Edwards, a small group, of which the Etisus dentatus is an example. This species is about four inches in length, and inhabits the seas of the Indian archipelago. The carapace is represented at Fig. 3131.

There are several genera of crabs, constituting a group called Notopods (Notopods), which have the feet of the fourth and fifth pairs elevated on the back, and not terminated with paddles, and the eyes supported by simple peduncles. To this group belongs the genus Dorippe, Dromia, &c.

The genus Dorippe has small claws, short and equal; the other feet are long and compressed, the third pair being the largest; the two last pair are elevated upon the back, and terminated by a small hooked nail, which is folded back upon the next joint. The eyes are small and lateral; the external antennæ rather long and setaceous. The species are widely distributed, inhabiting the seas of the warmer climates, as the Mediterranean, the Adriatic, and those of Manilla, &c. They seldom visit the shore, but haunt great depths, and it is probable that, as in Dromia, they use the hinder limbs for the purpose of covering themselves with foreign bodies, by way of shelter and concealment. Of their habits, however, very little is known.

The Dorippe lanata, Fig. 3132, is found in the Mediterranean; the body and limbs are covered with reddish down. It is the Cancer lanatus of Linnæus. From the genus Dorippe has been separated that termed Ethusa by M. Roux, and which may be distinguished from the former by the simple character of the orifice leading to the respiratory cavities. In Dorippe, there is on each side at the base of the anterior or claw-limbs, an aperture in the form of a button-hole, oblique, ciliated on its edges, and longitudinally stopped by a diaphragm, which communicates with the branchiæ, and serves as an outlet for the water which leaves them. In Ethusa this is a fissure of the ordinary character. The Ethusa Mascarone, Fig. 3133, from the Mediterranean is an example. It is the Cancer Mascarone of Herbot.

The genus Dromia, one of the Notopods, is remarkable for the hirsute character of the limbs and carapace; the claw limbs are large and strong; the fourth and fifth feet are elevated on the back, and the last joint which is bent is opposed to a spine which terminates the penultimate joint. The eyes are small, and rather approximated. The species of this genus are extensively distributed through the seas of the warmer climates; they are indolent in their habits, and live in spots where the sea is moderately deep, and rocks afford them snug places of refuge. Generally they are found covered with the valves of Conchifera, or with as pecies of fleshy polype (alcyonium), which they place and secure by means of their posterior limbs, and which mask them from the notice of enemies. The alcyonia, once fixed on the carapace, develop and extend themselves, and at last entirely conceal it. In July the females rouse from their lethargic indolence and betake themselves to the shallows for the purpose of depositing their eggs.

The Dromia hirsutissima, Fig. 3134, is found at the Cape of Good Hope. It is covered with long red hairs.

Closely allied to Dromia is the genus Dynomene, in which the ocular peduncles are rather elongated, and the two posterior feet only dorsal, and much inferior in size to the other. The carapace is somewhat heart-shaped.

The only recorded example is the Dynomene hispida, a small species covered with hair, and found on the shores of the Isle of France. It is represented at Fig. 3135.

We now turn to species more terrestrial in their habits, and capable of living for a considerable time out of water from which they often wander to great distances. To the groups which display these habits may be referred the Thelphusians, certain fluviatile crabs, which Milne Edwards regards as constituting a link between the Cancerians and the true land crabs. In general form they approach Eriphia; but they differ in habits, living in the earth about the banks of rivers, or in humid forests. Several species are known. The restricted genus Thelphusa is represented by a species well known in the South of Italy, Greece, Egypt, and Syria; the Crâbe fluviatile of Belon, Thelphusa fluviatilis, Fig. 3136.

This species, which was well known to the ancients, and is figured on many of the Sicilian and Grecian medals, is very common on the borders of the rivulets, streams and lakes of the south of Italy, where it makes its burrows. The Greek monks, according to Cuvier, eat it raw, and during Lent it forms one of the dishes of the Italians. Its carapace is about two inches in diameter both transversely and longitudinally. The general colour is pale gray. The upper surface is smooth, with little furrows and asperities anteriorly along the sides. The claws are rough, of a reddish brown colour at the extremities; they are long, conical, and unequally dentated: *a*, the external jaw-foot. Other species are natives of India and Africa.

An allied genus, Boscia, presents us with a species (the only one known) from the Antilles and South America. Like the Thelphusa, it is terrestrial, making burrows along the banks of rivers. M. Milne Edwards states that a dissection of an individual well preserved in spirit, by M. Audouin and himself, discovered to them a very remarkable disposition of the branchial apparatus of this crustacean. The cavities which enclose the breathing organs are elevated far above the upper surface of the branchiæ, and present a great vacant space, the walls of which are lined with a tomentose membrane, found to be covered with vegetation. The extensive branchial cavities are most probably intended in this crab for containing a due supply of water for laving the branchiæ; but with respect to the vegetation noticed by MM. Milne Edwards and Audouin, it appears to us to have been accidental; it is however an interesting circumstance, and one out of many examples in which parasitic vegetation has been found to become developed in or upon living animal bodies. Fig. 3137 represents the Boscia dentata, about a third of the natural size. *a*, the antennary margin of the carapace; *b*, the external foot-jaw.

We may now refer to a group of land crabs termed Ocypodians, remarkable for their extreme rapidity, which is such, says Cuvier, that a horseman has some difficulty in overtaking them; hence the term 'cavalier' which the older naturalists applied to them. They live in burrows which they excavate in the sand or along the margin of the shore.

The carapace is rhomboidal and much elevated anteriorly. The eyes are long; the cornea generally large and transparent. The anterior limbs are generally very compressed, and of unequal size; the rest are long, and often terminate in compressed points.

In the restricted genus Ocypoda, the cornea is transparent and very large, of an oval figure, occupying at least the half of the length of the ocular peduncles, and commencing very near the base of those stems. The orbital furrows are very large, but not deep. In the male the difference in size between the anterior or claw-limbs of each side is very considerable; in the female, it is less striking. The species are widely distributed. One, the Ocypoda Hippea, inhabits the coasts of Syria, and the Mediterranean borders of Africa. It is distinguished by a tuft of hairs, which terminates the ocular peduncles. Other species are Indian and American.

Fig. 3138 represents the Ocypoda arenaria, or Sand Crab of Catesby; a native of the coasts of North America and the Antilles. *a*, the under side of the head.

The habits of this species are very singular. During the whole of the summer months, it lives on the shore, excavating for itself a burrow three or four feet in depth, above the line of the highest tides or dash of the waves. In this retreat it secludes itself during the day, coming abroad on the approach of dusk to seek for food—it traverses the shore very nimbly, and when pursued darts away with great velocity, at the same time elevating its claws by way of menace. On the approach of winter, or towards the end of October, troops of these crabs leave the sea-side, and march inland, till, arriving at some suitable spot, they dig deep holes like those along the shore, for the purpose of hybernation. Into these they enter, stopping up the entrance with such address, that no trace of excavation is left. They then retire to the bottom, and remain quiescent, till the return of spring, when, animated by the warm weather, they emerge from their dormitories, retrace their steps to the sea-side, and set about repairing their old dwellings.

Certain species of the genus Ocypoda, as we have said, carry a tuft of hairs at the extremity of their ocular peduncles; others, an appendage in the form of a tubercle, cylinder, or stylet, which overpasses the transparent cornea. We mentioned the Ocypoda hippea of Northern Africa as an example, its ocular peduncles being tufted. Fig. 3139 represents this curious species. *a*, the claw; *b*, the under surface of the male.

The next genus of the Ocypodians is Gelasimus. In this form, the cornea is very small and rounded, and seated at the top of a long peduncle. In the females the anterior or claw-limbs are very small, but in the males one is enormously developed, while the other remains undeveloped, being in fact shorter and more feeble than the succeeding limbs. It is sometimes the right and sometimes the left of the anterior limbs which becomes enlarged, often indeed to such a magnitude as to make the body appear trifling in comparison. It appears that some of the species have at a certain age, if not always, a stylet at the extremity of the ocular peduncle, on the side of the great claw, whilst the eye on the side of the undeveloped claw always retains its ordinary form.

The Gelasimi are found in the warm countries of both hemispheres; they live on the sea shore, or on the borders of saline marshes, and burrow deep cylindrical holes running obliquely downwards, and often so close together, and in such numbers, as to form a sort of crab-warren. Each burrow is tenanted by a pair of these crabs, and the male keeps guard, closing the entrance with its great claw. While running over the ground, these crustaceans usually keep the large claw elevated before the body, as if making a signal in order to call to some one, and from this habit they have obtained the name of callers or beckoners, 'Crâbes appellants.' The species are very numerous, but like the Ocypodæ they are difficult to be distinguished, because the parts which differ the most, namely the front and the great claw, change their form with the progressive age of the animal. One species observed in South Carolina by M. Bosc, passes the three winter months in its retreat, and does not seek the water until the period of depositing its eggs.

Fig. 3140 represents the Gelasimus annulipes from the Indian Seas. *a*, the under side of the head; *b*, the abdomen; *c*, one of the antennæ.

Fig. 3141 represents the Gelasimus Marionis, from Manilla.

Like the species of the restricted genus Ocypoda, the Gelasimi are singularly rapid, traversing the shore with such celerity that it is by no means an easy thing to overtake them; nor are they incapable of defence, as may be readily conceived from the magnitude of the great claw, which is extremely powerful, and well adapted for inflicting a severe gripe with the pincers, or even a lacerated wound, the serrations of the opposed edges being very sharp.

We may now advance to a group of land crabs termed the Gecarcinians, known to the French under various names, as Toulouroux, Crâbes peints, and Crâbes violets, &c.

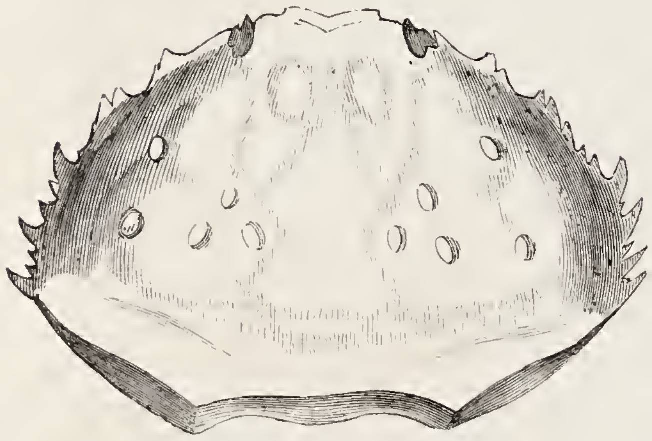
The Gecarcinians are, as it would appear, even more exclusively terrestrial than the Ocypodians, and so decidedly organized are the branchiæ for aërial respiration, that if submerged for any length of time in the sea, the animals perish from suffo-

3136.—Thelphusa fluviatilis.

3134.—Dromia hirsutissima.

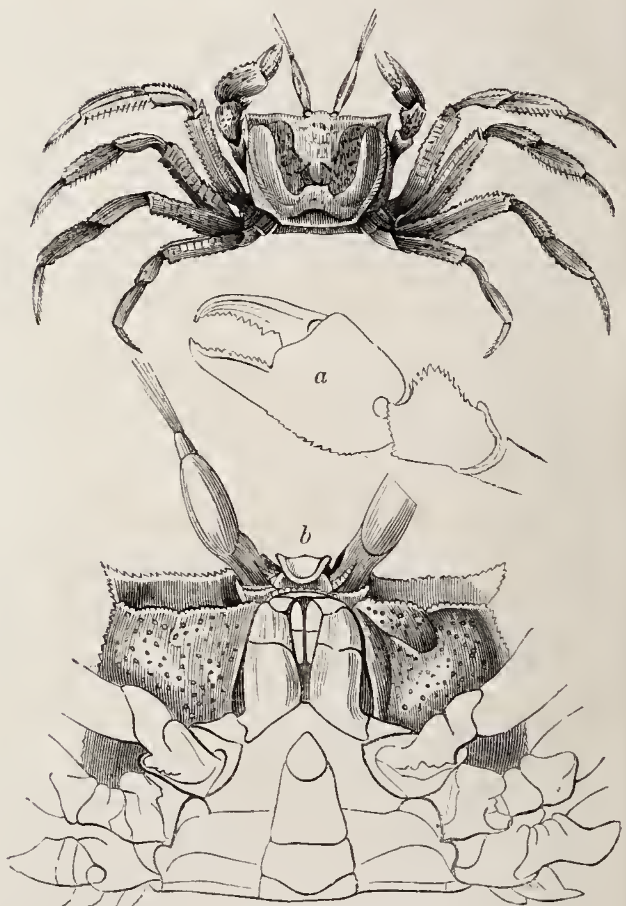
3141.—Gelasimus Marionis.

3133.—Ethusa Mascarone.

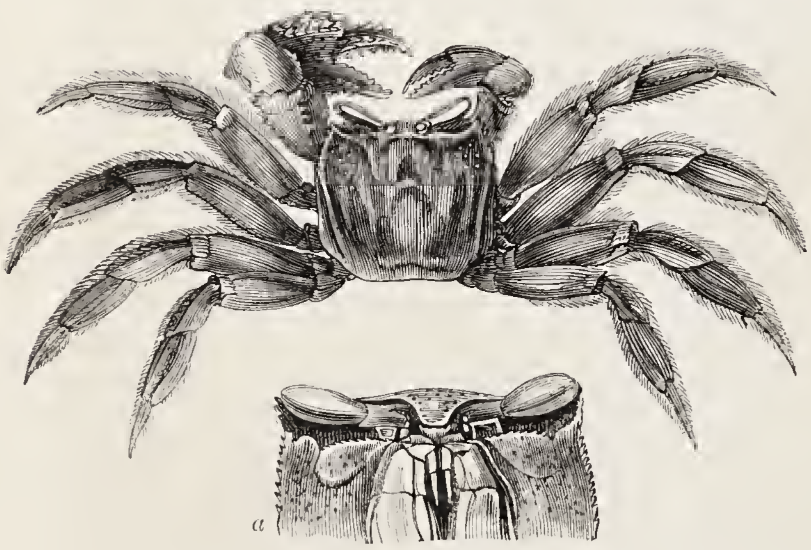


3131.—Carapace of Etisus dentatus.

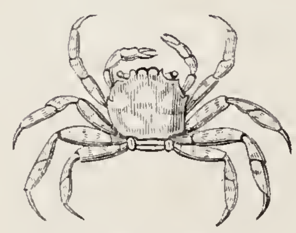
3135.—Dynomene hispida.



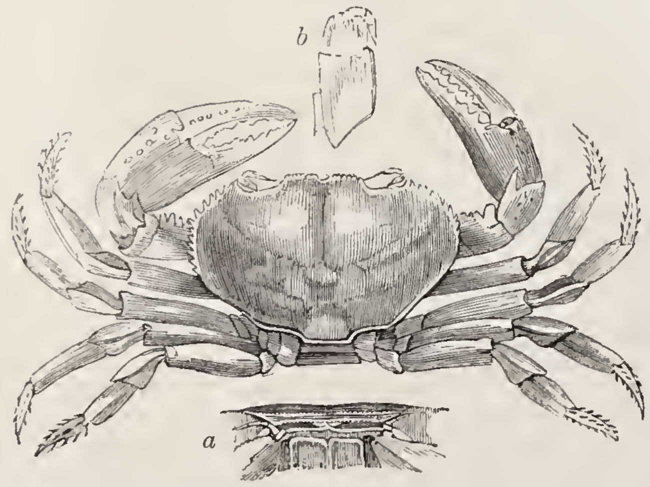
3139.—Ocypoda hippea.



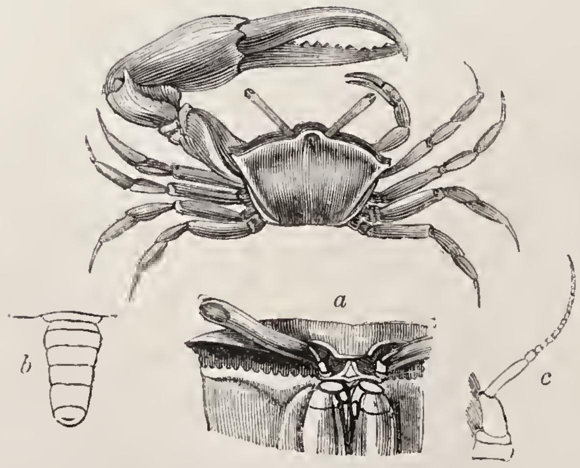
3138.—Ocypode arenaria.



3130.—Melia tesselata.



3137.—Boscia dentata.



3140.—Gelasimus annulipes.

3132.—Dorippe lanata.

3143.—Cardisoma carnifex.

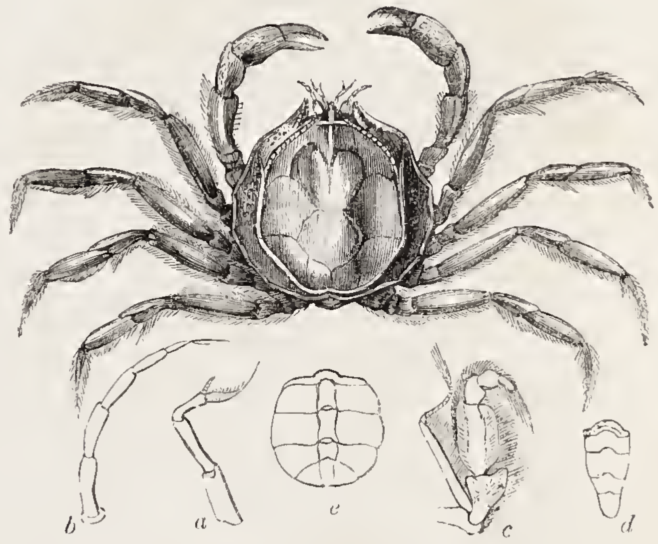
3148.—Plagusia clavimana.

3145.—Gonoplax rhomboïdes.

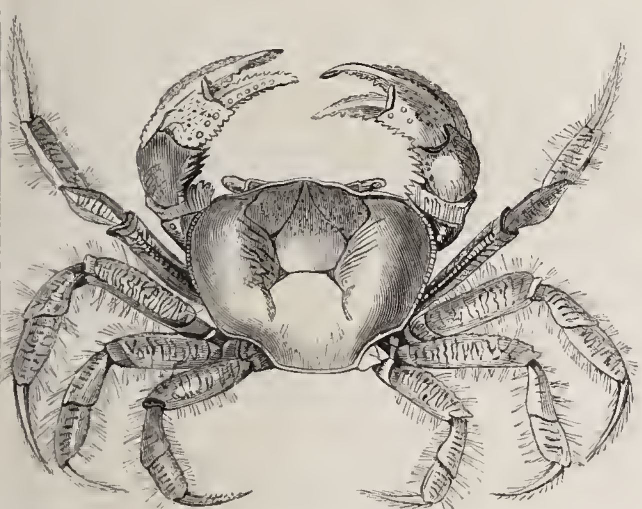
3150.—Pinnotheres veterum.

3146.—Grapsus pictus.

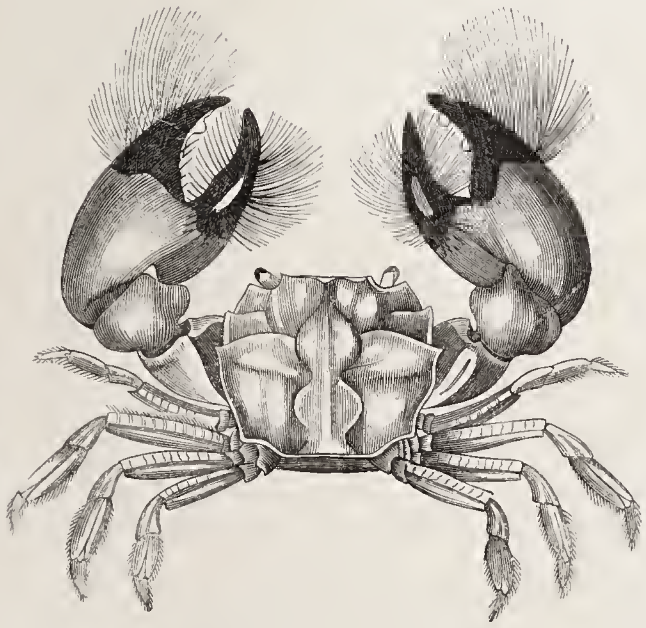
3149.—Pinnotheres.



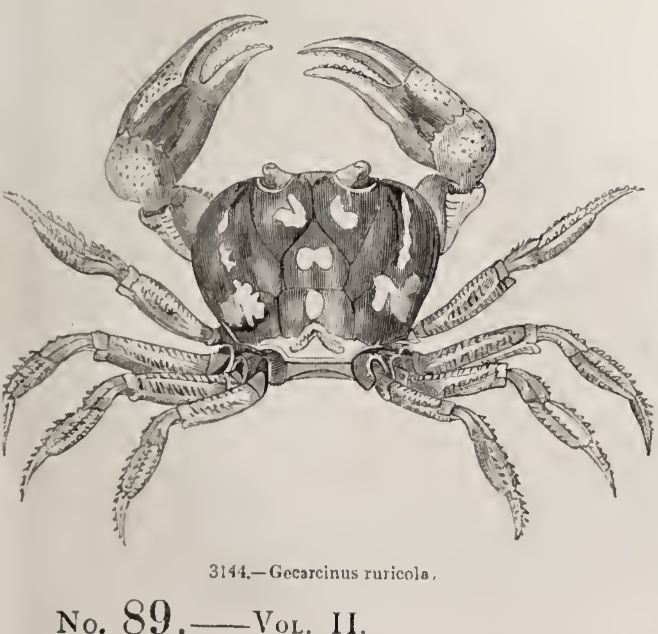
3151.—Hymenosoma orbiculare.



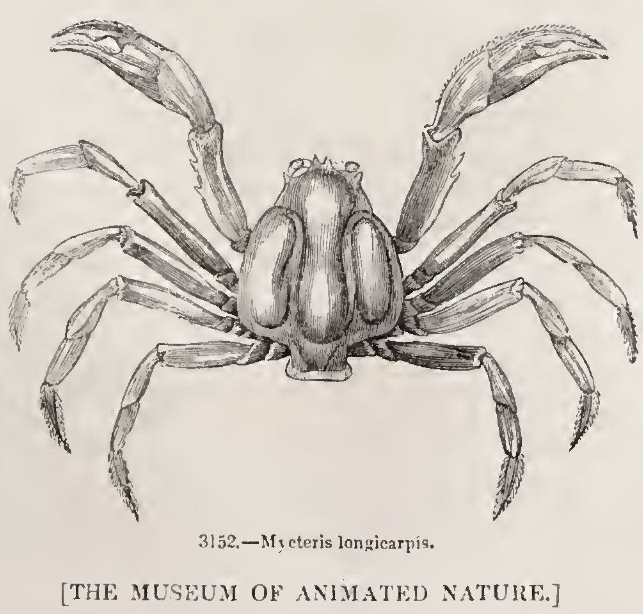
3142.—Uça Una.



3147.—Pseudograpsus penciliger.



3144.—Gecarcinus ruricola.



3152.—Mycteris longicarpis.

3153.—Doto sulcatus.

cation: nevertheless it is essential that the branchiæ be always kept moist, for death equally results from the desiccation of these organs. We have previously alluded to the size of the branchial cavity in the Ocypodians, and in the present tribe the same conformation exists. This cavity on each side is not only very ample, being raised into a vault highly elevated above the branchiæ, but the tegumentary membrane which lines it is also very spongy, and is often disposed into a sort of fold along the lower edge of the cavity, so as to form a gutter or longitudinal trough for containing water when the animal remains exposed to the air. It has been shown by MM. Milne Edwards and Audouin ('De la Respiration aërienne des Crustacés, et des modifications que l'appareil branchial éprouve dans les Crabes terrestres'), that in all the Crustacea the branchiæ are fitted to perform the functions of respiratory organs in the air as well as in the water; that the more or less rapid death of the aquatic species when exposed to the air depends upon various causes, of which one of the most direct is the evaporation from the branchiæ, and that, consequently, one of the conditions necessary to the support of life in animals which have branchiæ and live in the air, is that these organs be kept moist, and always defended from desiccation. In the land-crabs these arrangements and provisions are proved actually to occur. They possess various organs destined for absorbing and keeping in reserve the quantity of moisture necessary for supplying the branchiæ with a due proportion of fluid; in fact, for maintaining them in working condition.

The land-crabs are distributed' through the warmer regions of the Old and New World, and Australasia, but the species are most numerous in America and its islands. In their descriptions, however, of the habits of these animals, the writers who supply us with the most interesting details, viz., De Labat, Sloane, Brown, Hughes, Catesby, &c. ('Nouveau Voyage aux Isles d'Amerique;' 'Natural History of Jamaica;' 'Civil and Natural History of Jamaica;' 'Natural History of Barbadoes;' 'Natural History of Carolina'), seldom attend to the particular species, or enable us positively to identify that to which their details immediately refer. All the Gecarcinians, however, live more or less inland, paying at stated periods a short visit to the sea, the females for the purpose of disencumbering themselves of the eggs, which are carried under the abdomen. On land they dwell in burrows, where they undergo the process of exuviation. Their history, says Latreille, in Cuvier's 'Règne Animal,' may be summed up as follows:—"They pass the greatest part of their life on land, hiding in burrows, whence they issue forth in the evening; some take up their abode in graveyards. Once a year, when they would lay their eggs, they assemble in numerous troops, and take the shortest course to the sea, without being deterred by any obstacles which they may meet with on the road. After the deposition of the eggs, they return in a state of great debility. During the season of exuviation they block up, as is stated, the mouths of their burrows; whilst undergoing this process, and still soft, they are termed '*boursiers*,' or Purse-crabs, and their flesh is then held in high estimation; nevertheless it is sometimes deleterious. This quality is attributed to the fruit of the manchineel (mancenillier), of which it is supposed, perhaps without foundation, that they have eaten."

We may here remark that these Boursiers, or land-crabs in a state of moult, and covered only by a soft membrane, must not be confounded with the Birgus Latro, or Robber Crab, a native of Amboyna, called by Rumphius Cancer crumentatus, or Purse-crab, from its shape. It was from a confusion occasioned by this name of "Purse-crab," that Linnæus assigned the Antilles as well as Amboyna as the locality of Birgus Latro (Cancer Latro). He gives Rochefort ('Hist. Nat. et Morale des Isles Antilles de l'Amérique,' 4to., Rotterdam, 1681) as his authority, but the purse-crabs to which Rochefort alludes are the "Crabes peintes" during their state of moult. His words are:—"What is most remarkable in these crabs is, that once a year, namely, after their return from their seaward journey, they all hide themselves in the ground for about six weeks, so that not one is to be seen. During this time they change their skin or shell, and entirely renew themselves. At this juncture they so neatly close the mouths of their burrows with earth, that no opening is perceptible; this they do to exclude the air, for when they thus cast off their old garment, their whole body is, as it were, naked, being only invested with a tender and delicate pellicle, which by degrees thickens and hardens into a crust, according in solidity to that which they have quitted. M. du Montel states that he has purposely directed the places to be dug up in which there was the appearance of these animals being concealed; and having, in fact, found them, he remarked that they were enveloped in leaves, which, doubtless, served them both for food and a nest during their retirement, but they were so languishing, and so incapable of supporting the fresh air, that they appeared half dead, though otherwise; they were fat and very delicate eating. The inhabitants of the islands call them at that season "Crabes boursières," purse-crabs, and greatly esteem them. Close to them he found their old slough, that is, their shell, which appeared as perfect as if the animal were still within it; and strange it is that, although he used good eyes, scarcely could he discover the opening or slit whence the body of the creature had emerged, and became freed from that prison. However, after very careful scrutiny, he remarked in these sloughs a little separation at the side of the tail, through which the crabs had extricated themselves.

To return to the asserted poisonous quality of these crabs; though, perhaps, it may be attributed to a wrong cause, the fact itself is noticed by many writers. Sloane ('Nat. Hist. of Jamaica') observes that they are accounted poisonous when they feed on the mansanilla tree, which he thinks may arise from portions adhering about the mouth, or remaining still undigested in their stomach. Catesby, who says that some of these crabs are black, some yellow, some red, others variegated with yellow, white, and red, states that the black kind, in particular, are often noxious, and that the light-coloured kind are reckoned the best; when in full flesh, very well tasted. He adds that they feed on vegetables. Hughes observes that the large white crab feeds on vegetables, and likewise upon manchineel apples, and the leaves and berries of poison-trees, and that after the latter food it is not to be eaten with safety.

M. Milne Edwards in his account of these singular crabs remarks that they ordinarily haunt humid places, and hide themselves in burrows, which they excavate in the earth: each species, however, has its peculiar locality. Some, for example, live in the low marshy lands near the sea, others on the wooded hills at a distance from the shore. At certain epochs these last quit their habitual dwellings and journey to the sea; it is, indeed, reported that they unite in great bands, and thus make way unimpeded by any obstacle, and laying waste everything in their course. Their principal food consists of vegetable substances, which they wander to procure during the hours of darkness; and in the rainy season in particular quit their burrows, and may be seen running along with great rapidity. It would appear that at the time of laying they go to the sea, and there deposit their eggs, but, he adds, we have no decided information on this point. During their moult they remain hidden in their burrows.

In our introductory observations on the Crustacea, we stated that, according to Mr. Thompson, the young undergo certain transformations before assuming their permanent form. It was on the eggs, and young just hatched, of one of the West Indian Gecarcinians, in the collection of the late Rev. Lansdown Guilding, that Mr. Westwood made his observations (published in the 'Phil. Trans.,' 1835), proving that, in the species at least which he examined, no such metamorphosis takes place.

The first genus to be noticed of this tribe is that termed Uça by Latreille. One species, Uça Una (Cancer cordatus and Cancer Uça, Linn.), is represented at Fig. 3142. It inhabits the marshy grounds of Guiana and Brazil. The claw-limbs are spiny; the other limbs hairy below. Its manners are not well known.

Another genus is termed Cardisoma; to this belong the white crabs of the Antilles, so called in contradistinction to the dark or black, for the shell is yellowish with stains of red. The species give preference to woods, digging deep holes, and wandering abroad at night. As an example we refer to Cardisoma carnifex, Fig. 3143. This crab is found in the neighbourhood of Pondicherry. We know not whether it is to this genus or not that a singular land-crab belongs observed in India by the late Bishop Heber, living, to his surprise, a great distance from the sea. "The plain of Poonah," he says, "is very bare of trees, and though there are some gardens immediately around the city, yet as both these and the city itself lie in a small hollow on the banks of the river Moola, they are not sufficiently conspicuous to interrupt the general character of nakedness in the picture, any more than the few young trees and ornamented shrubs with which the bungalows of the cantonment are intermingled. The principal and most pleasing feature is a small hill, immediately over the town, with a temple of the goddess Parvati on its summit, and a large tank, which, when I saw it, was nearly dry at its base. All the grass-land round this tank, and generally through the Deccan, swarms with a small land-crab, which burrows in the ground, and runs with considerable swiftness, even when encumbered with a bundle of food almost as big as itself. This food is grass, or the green stalks of rice; and it is amusing to see them sitting, as it were upright, to cut their hay with their sharp pincers, then waddling off with the sheaf to their holes, as fast as their sidelong pace will carry them." Instead of going to the sea in order to deposit their eggs, may not these crabs resort to the tanks and rivers of the country, and may not the species belong to the fluviatile Thelphusians? Of this group, indeed, Leschenault discovered a species in the mountains of Ceylon; and another, the Cancer senex of Herbert, also inhabits the East Indies. If, however, this little crab be a true Gecarcinian, we see no reason why it should not be a visitant to fresh instead of saline waters.

We pass to the restricted genus Gecarcinus, of which the Black or Mountain crab, the Violet crab, or Toulourou, Gecarcinus ruricola, Fig. 3144, is an example.

"These creatures," says Brown ('Civil and Natural History of Jamaica') "are very numerous in some parts of Jamaica, as well as in the neighbouring islands, and on the coast of the main continent; they are generally of a dark purple colour, but this often varies, and you frequently find them spotted, or entirely of another hue. They live chiefly on dry land, and at a considerable distance from the sea, which, however, they visit once a year to wash off their spawn, and afterwards return to the woods and higher lands, where they continue for the remaining part of the season; nor do the young ones ever fail to follow them as soon as they are able to crawl. The old crabs generally regain their habitations in the mountains, which are seldom within less than a mile and not often above three from the shore, by the latter end of June, and then provide themselves with convenient burrows, in which they pass the greatest part of the day, going out only at night to feed. In December and January they begin to be in spawn, and are then very fat and delicate, but continue to grow richer until the month of May, which is the season for them to wash off their eggs. They begin to move down in February, and are very much abroad in March and April, which seems to be the time for the impregnation of their eggs; the males about this time begin to lose their flavour and richness of their juices. The eggs as they pass are entangled in the branchial capillaments, with which the under side of the apron is copiously supplied, to which they stick by the means of their proper gluten, until the creatures reach the surf, where they wash them all off, and then they begin to return back again to the mountains. It is remarkable that the bag or stomach* of this creature changes its juices with the state of the body; and while poor is full of a black, bitter, disagreeable fluid, which diminishes as it fattens, and at length acquires a delicate rich flavour. About the month of July or August the crabs fatten again and prepare for mouldering, filling up their burrows with dry grass, leaves, and abundance of other materials: when the proper period comes, each retires to his hole, shuts up the passage, and remains quite inactive until he gets rid of his old shell and is fully provided with a new one. How long they continue in this state is uncertain, but the shell is observed to burst both at the back and sides to give a passage to the body, and it extracts its limbs from all the other parts gradually afterward. At this time the fish is in the richest state, and covered only with a tender membranous skin, variegated with a multitude of reddish veins; but this hardens gradually after, and becomes soon a perfect shell like the former; it is, however, remarkable that during this change there are some stony concretions always formed in the bag, which waste and dissolve gradually as the creature forms and perfects its new crust. A wonderful mechanism! This crab runs very fast, and always endeavours to get into some hole or crevice on the approach of danger; nor does it wholly depend on its art and swiftness, for while it retreats it keeps both claws expanded, ready to catch the offender if he should come within its reach, and if it succeeds on these occasions it commonly throws off the claw, which continues to squeeze with incredible force for near a minute after; while he, regardless of the loss, endeavours to make his escape and to gain a more secure or a more lonely covert, contented to renew his limb with his coat at the ensuing change; nor would it grudge to lose many of the others to preserve the trunk entire, though each comes off with more labour and reluctance as their numbers lessen."

As an article of food this species is highly prized in the West Indies, and consequently in great demand. Brown says that the black crab, when fat, and in a perfect state, surpasses everything of the sort in flavour and delicacy; it frequently joins a little of the bitter with its native richness, which renders it not only more agreeable in general, but makes it sit extremely easy upon the stomach.

* Query—Is the liver not meant here?

They are frequently boiled and served up whole, but are commonly stewed when served up at the more sumptuous tables. We believe that when simply cooked in its own juices, in its shell, a squeeze of lime-juice is all that it requires to render it delicious. We do not see why these land-crabs may not with proper care be as regularly sent to our metropolis as turtle; surely they would not be unworthy the *epulæ adjiciales* of the city. The adjuncts may be the same as to Whitebait. But we must leave these crabs, so valued by the transatlantic epicurean, for others.

Between the Ocypodians and Grapsoïdeans, according to Milne Edwards, intervenes a tribe termed Gonoplaceans, having the carapace square or rhomboidal, and wider than it is long. The ocular peduncles are generally much elongated, and the eye, which terminates them, is small. To this tribe belongs the genus Gonoplax, in which the anterior pair of limbs are extremely elongated, and nearly cylindrical, appearing indeed far too much developed in comparison with the small square carapace between them at their base. The animals are marine.

The Gonoplax rhomboïdes, Fig. 3145, is a native of the Mediterranean and the ocean; it keeps among rocks at considerable depths, and appears to be solitary. It possesses considerable powers of swimming, and often rises to the surface of the water, but never comes on shore. Its length is about an inch (that is, of the carapace); and its colour yellowish mingled with red. Small fish and radiated animals constitute its food.

The Grapsoïdeans are less regularly quadrilateral than the Gonoplaceans, and the body is nearly always compressed; the ocular peduncles are thick, but short, and the eye occupies half their length. The anterior limbs are in general short, and the rest are very much compressed, the last pair sometimes assuming the natatory character. As far as their habits appear to be known, these crabs live much on the shore, or on the rocks bordering the coast, and on reefs of coral; they are very timid, and run with great alacrity.

The genus Grapsus contains those species remarkable for the extreme flatness of the body. The first pair of limbs are very short and spiny; the remaining limbs very much compressed, with the tarsal portion large, broad, and spiny.

One species, the Grapsus pictus, Fig. 3146, is very beautifully marked; it is of a reddish colour with irregular and waved stains of yellow; length about two inches. It is a native of the Antilles, and is not uncommon in collections.

The species of the genus Grapsus are widely spread. These animals, says Latreille, "conceal themselves during the day under stones and other bodies in the sea; some even, as I have been informed, climb on the trees of the shore, and creep under the bark; the broad and flattened form of the body and limbs gives them the faculty of sustaining themselves for an instant on the surface of the water; their progress on land is sideways, sometimes to the right, sometimes to the left. Certain species live in rivers where the tide comes in, but mostly on the borders of the water. They associate in considerable numbers, and on the appearance of any one betake themselves to the water, making a great noise with their claws, which they strike against each other. In general respects their mode of life resembles that of other carnivorous Crustacea."

From the genus Grapsus have been separated several subgenera, among which we may notice Pseudograpsus, in which the jaw-feet close the mouth, contrary to what is found in Grapsus—of this form, the Porte-pinceau (Grapsus penciliger), Fig. 3147, is an example. It is remarkable for the size of the claws in the male, and the tufts of long hairs which spring from them. The other limbs are furnished with thickset down. This crab is found in the seas of Asia.

Another subgenus is termed Plagusia. It is distinguished from Grapsus by the internal antennæ being bent back under the front and lodged in a deep notch so as to be uncovered above. The body and limbs are flattened. As an example we select the Plagusia clavimana (Cancer planissimus), Fig. 3148, a native of the shores of New Holland, New Zealand, Vanicoro, &c.

We now turn to a group of small crustaceans termed Pinnotherians, remarkable for their singular habits; they live housed between the mantle lobes of bivalve mollusks, as mussels, Pinnæ, &c., and were well known to the ancients, who have distinctly alluded to them, under the names of *πιννοτηρης, πιννοθηραςιν, πινοφυλαξ*; in Latin, Pinnotheras and Pinnophylax. They believed that a sort of partnership existed between these little crabs and the shell-fish, and that when the latter lay with the valves open, as a trap for prey, the crab gave notice to it when to close them upon its captive, after which they commenced the feast at leisure. Pliny describes the Pinnotheras as tenanting the empty shells of oysters; and in another place speaks of it as residing in the shell of the Pinna; but it is probable that under the same names he refers to two different crustaceans.

Hasselquist, the pupil and friend of Linnæus, in a letter to his great preceptor, dated Smyrna, December 16, 1749, gives another version of the services rendered by the Pinnotheres to the Pinna. "The time I have been here," he says, "has afforded me an opportunity of seeing the kinds both of fish and shell-fish which the Greeks use during their Lent. No people, I believe, make so much use of shell-fish and other marine animals as do the Greeks. I have seen them eat ten different sorts of shell-fish, when with us oysters only are eaten. Amongst other animals they sell here a sepia or cuttle-fish, which is by them called *ὀκτωπόδια* (Octopodia); it has only eight tentacula, all of equal length; and the animal is a foot long and thick in proportion. Of this the Greeks have related to me an anecdote which I think remarkable. The Pinna muricata, or great silk-mussel, is here found in large quantities at the bottom of the sea; and is a foot in length. The octopodia, or cuttle-fish with eight arms, watches the opportunity when the mussel opens its shell, to creep in it and devour the contents; but a little crab which has scarcely any shell, or at least only a thin one, lodges constantly in this shell-fish, and pays a good rent by saving the life of its landlady. This crab keeps a constant look-out through the aperture of the shell, and on seeing the approach of the enemy begins to stir, when the Pinna closes the valves and thus excludes the rapacious animal. I saw this shell-fish first at the island of Milo, and found such a little crab in all I opened; I wondered not a little what was its business there, but on coming here, the circumstances were explained to me by M. Juste, the secretary of our consul, a curious and ingenious man who has travelled much, and lived long in this place. The account was afterwards confirmed by several Greeks, who daily catch and eat both these animals."

The Pinnotherians are of small size, with a carapace nearly circular, with small and feeble limbs; the eyes are minute, on abbreviated peduncles.

In the restricted genus Pinnotheres, the parts of the mouth are developed; the external jaw feet are placed obliquely, and the third joint enlarged. Fig. 3149 represents the under side of the anterior part of Pinnotheres, displaying the eyes, jaw-feet, &c., magnified.

One species of Pinnotheres, the Pea-crab (P. Pisum), is very common in mussels on our coast. According to Mr. Thompson, it resembles Zoea in the early stages of its existence, having an elongated abdomen terminated by a fin, a carapace armed with three long spines, large eyes, and swimming feet.

Another species, the Pinnotheres veterum, Fig. 3150, is found in the Pinnæ, on the coasts of Greece and Italy. It measures about eight lines in length.

To the present group the genus Hymenosoma appears to be referable. The carapace is flattened and nearly circular, with a narrow front. The fore-limbs are small, the others slender but rather elongated. Fig. 3151 represents the Hymenosoma orbiculare, from the Cape of Good Hope. It measures an inch in length; two spiniform processes project anteriorly from the carapace, one on each side of the eyes: *a*, internal antenna; *b*, external antenna; *c*, external jaw-foot; *d*, abdomen of mail; *e*, abdomen of female.

Between Pinnotheres and Ocypodes, according to Milne Edwards, may be placed the genus Mycteris, characterized by the carapace being very delicate, nearly circular, and convex. The external jaw-feet are placed vertically, and form by their union a short and wide reversed cove; the limbs are long and slender. Fig. 3152 represents the Mycteris longicarpis, from the Australian Seas. The carapace is divided by furrows into three longitudinal tumuli, and projects anteriorly. Length about one inch.

A closely allied form has been characterized by Milne Edwards under the generic title of Doto. It approximates, in the general form of the body, feet, and eyes, to the Ocypodes, but in some other points to Mycteris. The species on which this genus is founded is figured by Savigny in the great work on Egypt; it is the Mycteris sulcatus of Audouin, Cancer sulcatus of Forsk, and Doto sulcatus of Milne Edwards.

The carapace is nearly square, and furrowed above; the front orbital border occupying nearly the whole of its width. The region around the mouth, and the external jaw-feet, equally furrowed; feet, rather long and compressed; length six lines. It is a native of the Red Sea. Fig. 3153 represents this crab magnified; *a*, a profile still more enlarged, without the legs, to show the grooves; *b*, a view of the under part of the carapace.

An extensive group of crabs, distinguished by the projection and acuteness of the anterior part of the carapace so as to form a snout, has been termed by Milne Edwards Oxyrhynchi. This group contains several tribes, of which one is the Macropodian; the species being remarkable for the enormous length of their limbs, which has obtained for them the name of Sea Spiders.

The form of the carapace is various, but in general triangular; the anterior limbs are feeble, slender, and shorter than the rest, which are more or less filiform; the basal joint of the external antennæ nearly always constitutes the major part of the lower wall of the orbit, and proceeds to solder itself to the front. The Macropodians inhabit the sea at considerable depths, where they lie concealed among the fronds of sea-weed; they are also found on oyster-banks; from the length and slenderness of their limbs they proceed slowly and unsteadily. Their food consists of minute mollusks and other soft marine animals. The first genus we shall notice is Leptopodia of Leach, remarkable for the excessive elongation of the limbs, and the manner in which the carapace is carried out anteriorly into a long styliform snout or rostrum. The eyes are comparatively large, and not retractile. The species are found on the coasts of America and the Antilles.

As an example of this genus we select the Leptopodia sagittaria (Cancer seticornis, Herbst; Trachus sagittarius, Fabricius). It is represented at Fig. 3154. In this species we have, as it were, in an exaggerated manner, all the distinctive character of the great group or family and tribe to which it belongs.

Another genus, the species of which are found in the European Seas, is termed Stenorhynchus. In this the rostrum is projecting, bifid, and sharp: the eyes are not retractile; the fore-limbs are much stouter than the others, which are long and filiform.

Fig. 3155 represents the Stenorhynchus phalangium (Cancerpha langium, Pennant; Cancer rostratus, Linn.; Macropus phalangium, Latreille; Macropodia phalangium, Leach). It is a native of the coasts on each side of the English Channel, and of the other seas of Europe.

In the seas of Asia are found various species of a genus termed Camposcia. In this the rostrum advances but little beyond the eyes, which are supported upon peduncles and not retractile, though capable of being reflected backwards. The carapace is convex and pear-shaped; the feet are slender. Fig. 3156 represents the Camposcia retusa; *a*, a view of the under surface of the head, showing the details of the eyes, antennæ, and mouth.

The genus Eurypodius is also found in the Asiatic Seas. In this the rostrum is formed by two long and horizontal horns; in the male the anterior limbs are as long as the body, but shorter in the female. The succeeding limbs are long and slender, and their terminal joint is curved and very sharp, and capable of being bent back against the lower edge of the preceding joint, so as to give to the animal the power of attaching itself firmly to any object.

Fig. 3157 represents the Eurypodius Latreillii; it is found on the shores of the Falkland Islands.

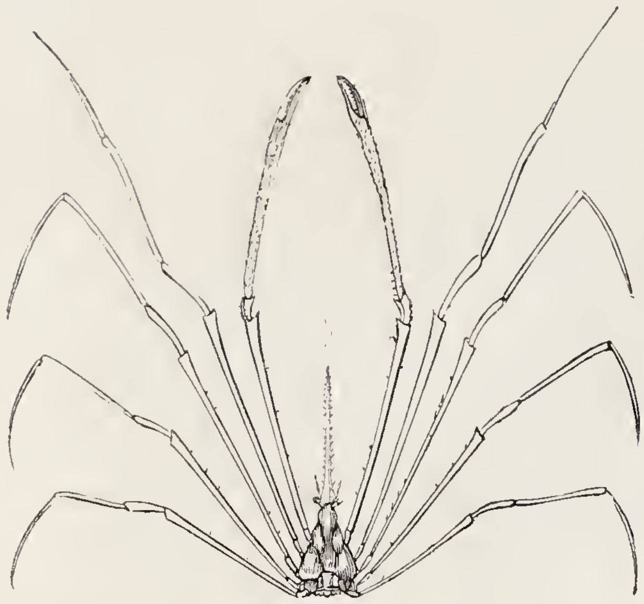
The genus Inachus as restricted by modern writers may here be noticed; it contains several small species natives of the seas of Europe, and found more particularly on the coasts of England and France. They haunt bays and coves, where beds of oysters exist, and all have the body and limbs covered with down and hairs; small sponges and corallines are often found attached to them.

The rostrum is short; the eyes are on peduncles capable of being reflected backwards and lodged in an orbitary cavity, which though not deep is distinct. The anterior limbs are stout and large in the male, very small in the female; the second pair are the longest. The carapace is triangular and much embossed above; the general colour is brownish. Fig. 3158 represents the Inachus Scorpio, a native of the British Channel, &c.: *a*, the male; *b*, the female; *c*, the abdomen of the male; *d*, the abdomen of the mature female; *e*, the abdomen of the immature female. Among several other genera belonging to this tribe, as Latreillia, Achæus, Amathia, &c., we may select for notice that termed by Dr. Leach Doclea.

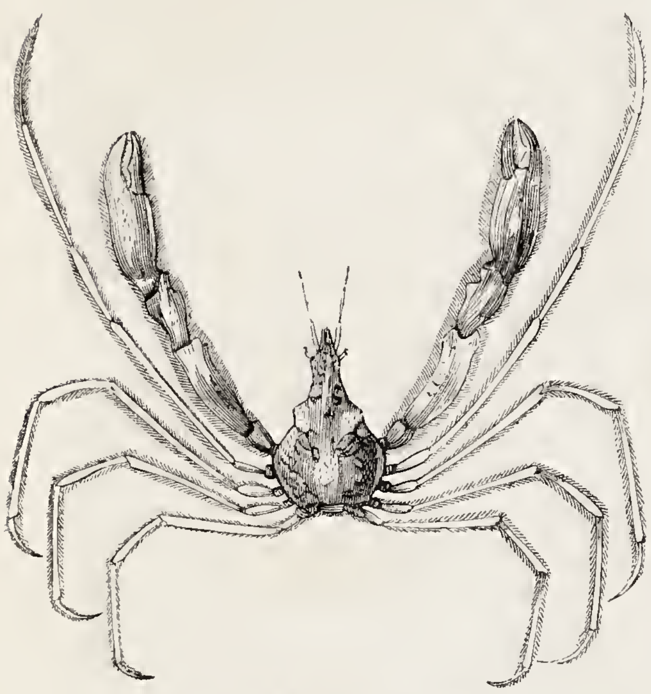
In this form the carapace is nearly globular, hairy, and more or less beset with spines; the rostrum is short and narrow; the eyes are very small, and entirely lodged on the orbits. The anterior limbs are very small and feeble; the succeeding limbs long. The species are found, as far as yet ascertained, in the Indian Seas. Fig. 3159 represents the Doclea Rissonii. According to Milne Edwards it forms a passage to the tribe of Maiians, or Maiidæ.

The tribe of Maiians, or Maiidæ, is composed of Oxyrhynchi, whose carapace is mostly spiny, and generally speaking longer than it is wide; the rostrum is usually bifid, or composed of two horns. In the males, the first pair of limbs are longer and more robust than the second pair; but in the females they do not exceed, and sometimes do not equal, the second pair. The succeeding feet are of moderate length.

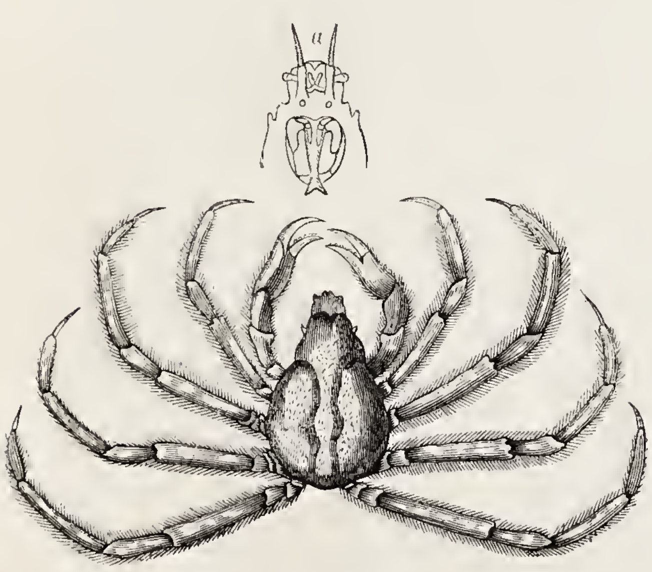
The first genus of this tribe which we notice is that termed Libinia by Leach: the carapace is nearly circular, and very convex above, the eyes are



3154.—Leptopodia sagittaria.

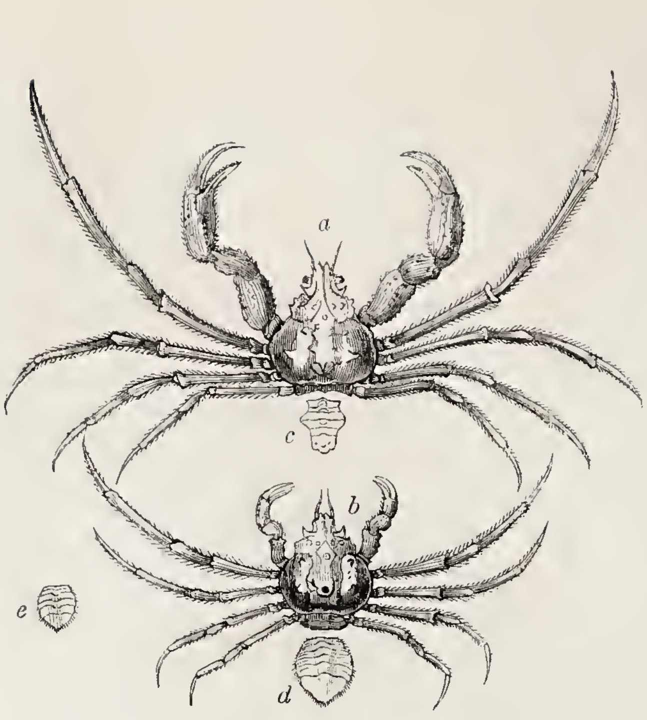


3155.—Stenorhynchus phalangium.



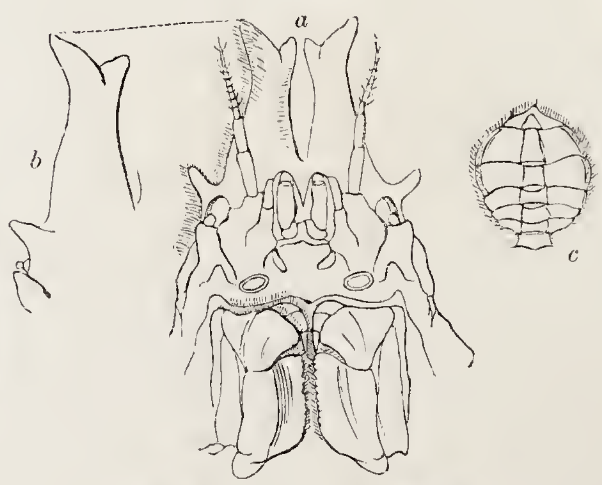
3156.—Camposcia retusa.

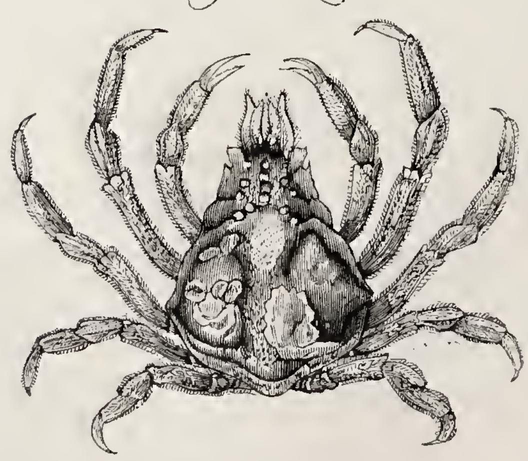
3157.—Eurypodius Latreillii.



3158.—Inachus Scorpio.

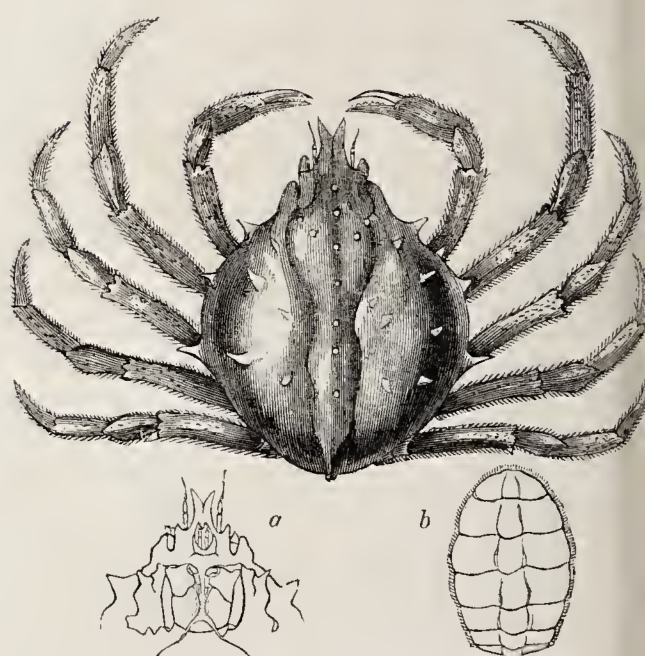
3159.—Doclea Rissonii.





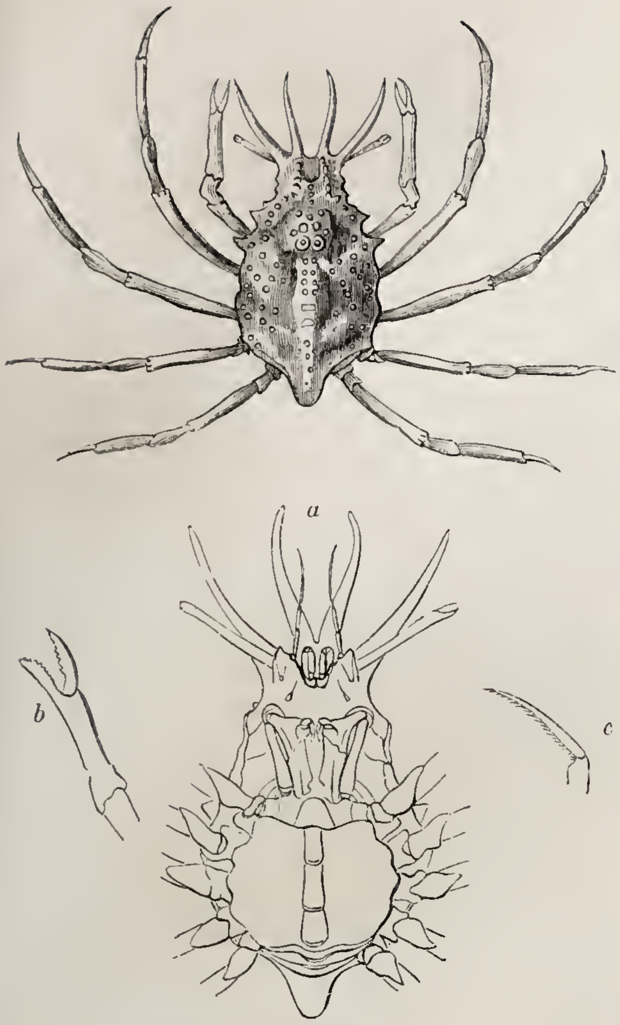
3163.—Naxia serpulifera.

3162.—Pisa tetraodon.

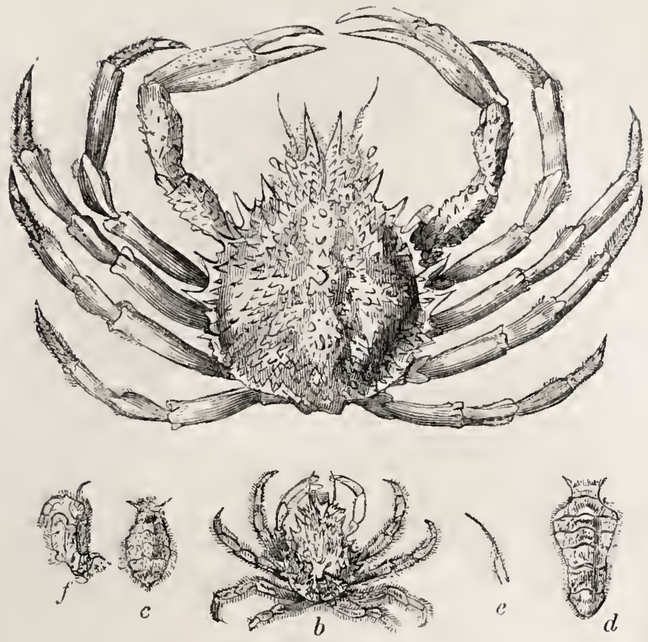


3160.—Libinia spinosa.

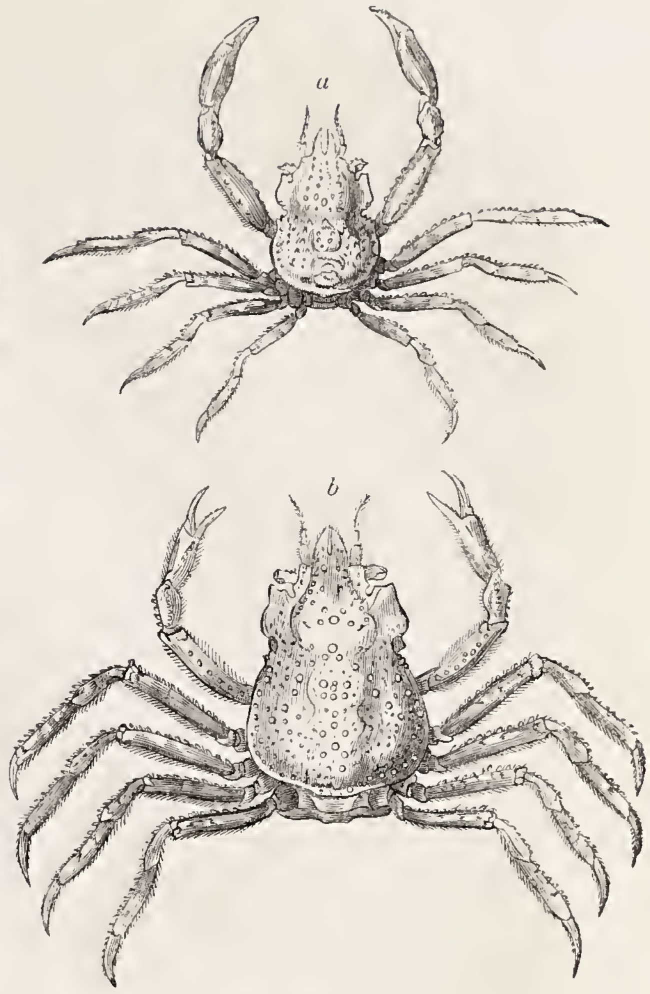
3161.—Herbstia condyliata.



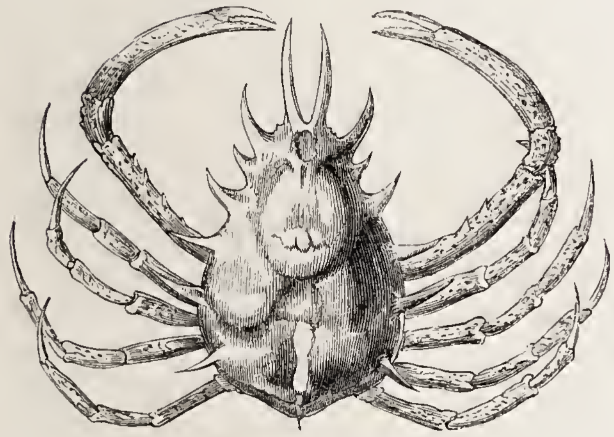
3172.—Stenocinops cervicornis.



3168.—Maia Squinado.

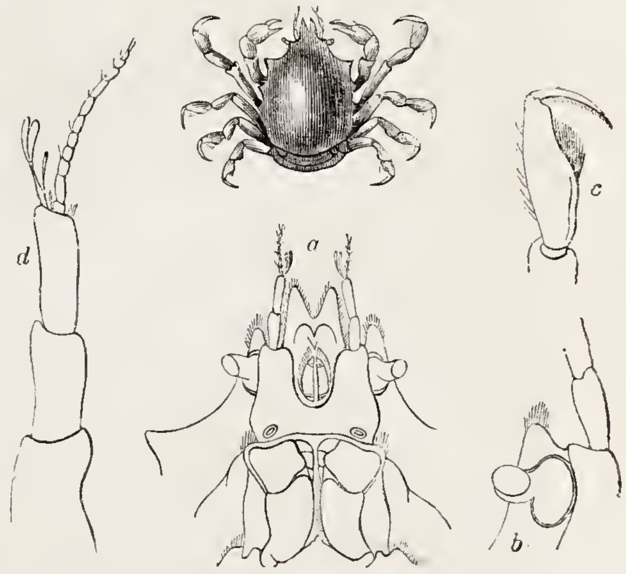


3164.—Hyas coarctata.



3171.—Pericera cornuta.

3167.—Mithras dichotomus.

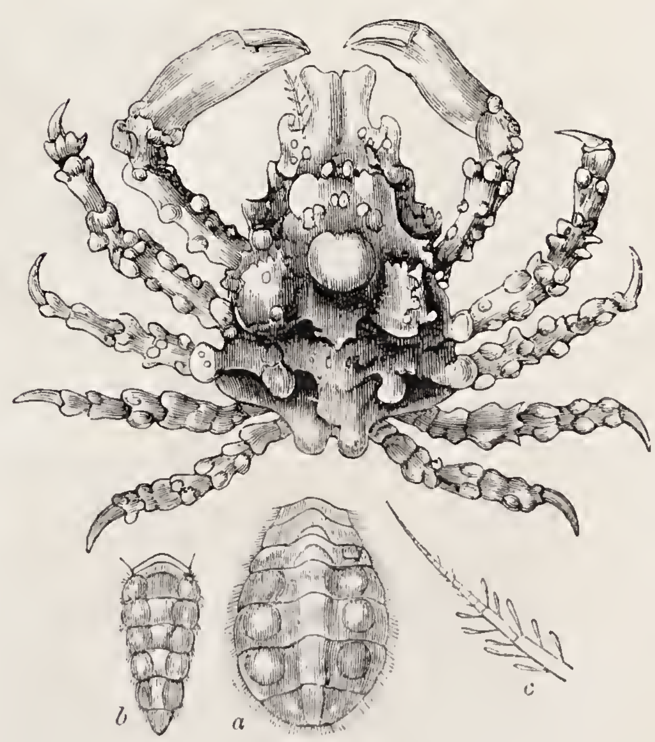


3174.—Acanthonyx lunulatus.

3169.—Micippa Philyra.

3166.—Chorinus Heros.

3170.—Criocarcinus superciliosus.



3163.—Lissa chiragra.

small and short, the orbits circular; the rostrum is small, and notched, or bifid. The anterior limbs, longer than in Doclea, are less developed than in some of the following genera. The species, as far as known, are all natives of the seas of America.

Fig. 3160 represents the Libinia spinosa, from the coasts of Brazil. *a*, the under side of the head in detail; *b*, the abdomen of the female.

The next genus is Herbstia, which has the carapace more triangular than Libinia. The rostrum is short and bifid, the orbits oval; the eyes large and retractile. The fore-limbs in the male are long and stout, exceeding the second pair, which in the female they only equal. One species only is known, Herbstia condyliata (Fig. 3161). This singular crab is a native of the Mediterranean; it is about two inches in length, has the body covered with fine down, and is of a reddish colour.

The genus Pisa here comes in. In this form the rostrum projects considerably, and is bifid, and at its base are two other and shorter spines, one on each side occupying the anterior part of the orbital border. The eyes are carried on short peduncles, and bent backwards in the orbits, which are of an oval shape, and directed outwards and downwards. In the male the anterior limbs are long and stout, exceeding the second pair in length, but only equalling them in the female. The claws are finely dentilated on their terminal portion. Of the succeeding limbs the last joint is regularly pectinated with horny points. Some species have spiniform teeth on the third and fourth joints of the four last pairs of limbs. Among these is the Pisa tetraodon (Fig. 3162). This species is common on the English and French coasts, living at considerable depths, and often dredged up by fishermen. After spring-tides they are frequently found hidden under stones at low water. The length is three inches; the body is entirely covered with down and some crooked hairs. General colour brown. The difference which exists between the male and female will be at once appreciated by referring to our pictorial specimens: *a*, the male; *b*, the female; *c*, abdomen of female; *d*, abdomen of male; *e*, antenna; *f*, pedipalp, or jaw-foot.

It has been observed that the Pisæ are covered with hairs, which are recurved at the end, and are hence apt to catch up foreign bodies, as the fibres of delicate seaweeds, sponges, &c., with which the body becomes as it were veiled; it is very probable that, thus disguised, they are the better enabled to surprise their prey, and to escape the observations of their numerous enemies.

Closely allied to Pisa is the genus Lissa of Dr. Leach, the principal distinguishing character consisting in the disposition of the rostrum, which is formed of two lamellose horns, truncated and wider anteriorly than at the base. There are no spines on the limbs. Fig. 3163 represents the Lissa chiragra, so called from the singular swellings and tuberosities with which it is covered, especially on the limbs, and which suggested the term chiragra (gouty on the hands). It is a native of the Mediterranean, but is occasionally found more northward, and said to have been taken on the coast of Cornwall. Referring to Fig. 3163, *a* is the abdomen of the female; *b*, the abdomen of the male; *c*, one of the antennæ. Another closely allied form is that termed by Dr. Leach Hyas. The first joint of the external antennæ is flattened instead of being cylindrical; the rostrum is bifid, each part being acute; the orbits are directed somewhat forwards. We select as an example the Hyas coarctata, Fig. 3164. This crab is found in the British Channel, and is about two inches in length. The carapace is strongly contracted (coarctate) beneath the external orbital angles. The general colour is reddish. The differences between the male and female may be easily appreciated by referring to the pictorial specimens: *a*, the male; *b*, the female.

M. Milne Edwards describes a genus under the name of Naxia, which he regards as nearly related to the genera Pisa and Lissa, but to be distinguished by the disposition of the antennæ and orbits; the rostrum closely resembles that of Lissa. The orbits are small, nearly circular, deep, and marked with a fissure above and below, but without any hiatus at their inferior border. The basal joint of the external antennæ is wide, narrowing forwards, and hidden beneath the rostrum.

Fig. 3165 represents Naxia serpulifera, one third its natural size. *a*, the under side of the head in detail; *b*, one of the protruding parts of the rostrum with the eye in profile; *c*, abdomen of female. This species is a native of the shores of New Holland, and is about four inches in length. The body is invested with brownish downy hairs, and the carapace is often encrusted with serpulæ, flustræ, sponges, &c.

Another remarkable genus of the Maiians is Chorinus (Leach). The rostrum consists of two large pointed horizontal horns; the eyes are retractile, and the orbits directed downwards. The anterior limbs are long, especially in the males; and the claw strongly curved inwards, dentilated, and pointed. The succeeding limbs are cylindrical; those next to the claw-limbs being of great length in the male.

Fig. 3166 represents the Chorinus Heros, one-half of the natural size. It varies in length from two to three inches, or rather more. Colour, yellowish red; rostrum, sides of carapace, and four last limbs hairy.

The singular genus Mithrax (Leach) here requires notice. The carapace is rather convex above, and narrowed anteriorly; the rostrum is short and bifid; the orbits are armed at their superior border with two or three spines, one at their external angle, and one or two at their inferior border; the margin of the carapace anteriorly is spiny. Anterior limbs generally rather robust in the male. The species of this genus are mostly limited to the seas of America, and some attain to considerable dimensions. We select as an example a species from the coasts of the Balearic Islands, viz., Mithrax dichotomus, Fig. 3167. It measures about two inches in length, and is of a yellowish colour. An allied genus (Paramithrax) is distributed through the Australasian Seas.

The genus Maia next succeeds. The carapace is rough with multitudinous spines and tubercles; the rostrum is horizontal and bifid, each branch diverging; the orbits are oval and deep. The anterior limbs are moderate, and somewhat cylindrical. The second joint of the lateral antennæ seems to spring from the internal angle of the orbitar cavity. General figure oval.

The Maia Squinado, common on our coasts and those of Europe, has been known from a remote period, and was figured on coins and medals. The ancients attributed to it great sagacity, and believed it sensible to the charms of music. As an emblem of wisdom, it was sculptured suspended from the neck of Diana, the goddess of the Ephesians.

Fig. 3168 represents this species, which attains to a considerable size. It is often dredged up in the British Channel, but it is not in any request as an article of food, though the fishermen sometimes eat it. Referring to Fig. 3168, *b* represents a young female; *c*, abdomen of female; *d*, abdomen of male; *e*, one of the antennæ; *f*, pedipalp. Passing from form to form, we pause to notice a genus, Micippa (Leach), which at first seems far removed from those around it. The carapace is not narrowed anteriorly, and appears as if truncate at its margin; if, however, we look underneath, we find a lamellose rostrum directed vertically downwards, so as to form a right angle with the axis of the body; on the sides of this rostrum are placed the orbits, fissured above. The ocular peduncles are retractile; the sides of the carapace are spined; the limbs are moderate, the first pair small; the external antennæ are large. The species are found in the Indian Seas, and about the coasts of the Isle of France. Fig. 3169 represents the Micippa Philyra. It is about two inches in length. Equally remarkable is the genus Criocarcinus (Guérin), the upper outline of which may be more readily understood by referring to our pictorial specimen, Fig. 3170, than by mere description: anteriorly the carapace pushes out into a bifid rostrum, each part taking an outward curve; from each side of the head stands out a toothed process, at least in the example selected; the sides are opened, and the posterior margin terminates in an acute projection. The orbitar cavities are nearly in the form of a long and truncated tube directed outwards; but they do not sheath the eyes, which terminate each a long slender peduncle, inserted so as to be completely exposed and capable of reflection backwards, when it is concealed under the orbital projection of the carapace.

The Criocarcinus superciliosus (Fig. 3170) is of small size, being about an inch and a half in length. Its exact locality is not ascertained.

Among the strange forms of this curious tribe is the genus Pericera. The rostrum branches out into two spines, and similar though smaller spines are ranged along each side. The orbits are circular, small, and deep, and sheath the ocular peduncles. The basal joint of the external antennæ is very large. The anterior limbs are cylindrical. The species, as far as ascertained, are natives of the seas of the Antilles.

Fig. 3171 represents the Pericera cornuta (Cancer cornudo, Herbert; the horned crab of Hughes).

It is from three to four inches long, and covered with a plush of brownish hairs.

Immediately related to the preceding is the genus Stenocinops. The rostrum consists of two long horns, and a similar horn projects over each orbit. The ocular stems are long, delicate, and immoveable. The limbs are slender. The carapace projects posteriorly. Fig. 3172 represents the female of Stenocinops cervicornis, the only known species. It is a native of the coasts of the Isle of France. *a* shows the under side in detail; *b*, the termination of one of the first pair of feet; *c*, the termination of one of the succeeding feet.

A genus termed Halimus by Latreille now follows. It is characterized, he says, by the peduncles of the eyes being retractile within the orbits (fossettes), and protected behind by a tooth-like process or angle of the lateral borders of the carapace. The second joint of the external antennæ is longer than the following, and they are terminated by a short stem. To this we may add that the rostrum projects in the form of two divergent horns. The species are natives of the Indian Seas.

We select as an example the Halimus Aries (Fig. 3173). It is about an inch in length. *a* shows the under surface of the head in detail; *b*, the eye, orbit, and spinous protection; *c*, one of the jaw-feet. Another genus referable to this tribe is Acanthonyx (Latreille). In many points it approaches Halimus. The orbits are circular, the rostrum bifid. Of the four posterior pair of limbs, the penultimate joint is enlarged, and notched near the end with a hairy tooth, against which the last joint, in the form of a sharp hooked claw, can be bent back for the purpose of clinging. The species are widely spread; some are found in the Mediterranean, others in seas of South Africa, and others on the coasts of the Antilles.

The Acanthonyx lunulatus frequents the coast of Provence and the Bay of Naples, inhabiting the crevices of rocks covered with fronds of seaweed. It is scarcely an inch in length. It is represented at Fig. 3174. *a*, the head in detail, viewed from beneath; *b*, the eye; *c*, the termination of one of the second pair of limbs; *d*, one of the antennæ magnified.

Approximated to the latter genus is one termed by Milne Edwards Epialtus. The carapace is somewhat hexagonal, convex, and smooth; the rostrum is triangular, narrow, and scarcely, if at all, divided. The eyes are very short, and the orbits circular. The antennæ are minute; the external jaw-feet large; the anterior limbs rather stout, the second pair longer than the succeeding, which indeed are short.

This form, as far as we know, is confined to some parts of the South America coast, as Chili.

Fig. 3175 represents the Epialtus tuberculatus, a minute species, about four lines long, and of a brownish yellow.

An allied genus is one termed by Milne Edwards Leucippa. The carapace is smooth, with lateral angular points; the rostrum is broad, and formed of two slips or lamellæ; the orbits are incomplete; the eyes are small and set on short peduncles. The external antennæ are rather long; the limbs short and compressed. This form, as far as is ascertained, belongs to the Pacific Ocean. Fig. 3176 represents the Leucippa pentagona, a minute crustacean only four lines in length, and of a pale grey. *a* shows the under surface of the head greatly magnified.

We now pass to a singular genus, Egeria (Leach), the affinities of which are not very clearly established. In the extraordinary length of the limbs it agrees with the Macropodians; but other points are yet doubtful. If, says Desmarest, the number of articulations composing the abdomen were seven, it would be nearly approximated to Maia, Pisa, Mithrax, and Micippa, in the form of its body; but if the number of articulations composing it be six, it would bear great relationship to Macropodia, Leptopodia, Doclea, &c. The species described, Egeria Indica, Fig. 3177, very much resembles Inachus Scorpio (Fig. 3158), but the claws are slender, and the other limbs more elongated. The antennæ are short, and inserted on the sides of the rostrum. The latter is moderate, and deeply bifid with diverging points. The eyes are larger than their peduncles. The species in question is a native of the Indian Seas.

To the Maiians is allied another tribe, called by Milne Edwards Parthenopians. The carapace is ordinarily triangular; the rostrum small and entire, or only notched at the end; the eyes are nearly always perfectly retractile. The basal joint of the external antennæ is in general short; the anterior limbs are much developed, and in the male are often long, with the claw curved. The other limbs are short. The number of joints varies on the abdomen of the male, but in the female there are always seven. These crustaceans are widely distributed; some are found in the British Seas and those of the adjacent continent, others in the seas of India.

The first genus is Eumedonus. The carapace is nearly pentagonal; the body depressed; the rostrum wide, much advanced, and notched anteriorly; the eyes are on short peduncles filling the orbits, which are circular. The internal antennæ are bent obliquely outwards; the external antennæ are but little developed. Abdominal segments in the male, seven.

Fig. 3178 represents the Eumedonus niger, a

small species from the coasts of China, remarkable for the great angular prolongation on each side of the carapace. The upper surface of the carapace is minutely granulated. The rostrum is wide and flat. The anterior limbs are armed with a strong spine, occupying the lower border of the carpal joint, and two small points are placed on the claw. The pincers are armed with rounded teeth. Colour bronzed black.

Allied to the former is the genus Euryonome; in which the carapace is nearly triangular, with a rounded base, much embossed and covered with asperities. The rostrum is horizontal, and divided into two triangular horns. The internal antennæ are bent back longitudinally; the external antennæ are under the rostrum, and appear to spring from the internal angle of the orbits. The first pair of limbs are rather long in the male; short in the female. Abdominal segments seven in both sexes.

Figs. 3179 and 3180 represent the Euryonome aspera, a small species, not exceeding half an inch in length; found in the British Channel, and on some parts of the coast of France, at considerable depths. Its colour is a roseate red, with bluish tints. The carapace presents a large triangular tooth at the external angles of the orbit, and three or four small teeth along the lateral margin. The limbs, except the first, are hairy.

We now advance to the genus Lambrus. In this singular form the carapace is as long as it is wide, rounded on the sides and narrowed forwards. The rostrum is small, but rather advanceable; the eyes are retractile, and placed on nearly circular orbits, which are fissured above, and present a deep and wide gap below the internal edge. The internal antennæ bend backwards obliquely, and the fossets in which they lodge are in general continuous with the orbits. The external antennæ are short. The first pair of limbs are of very great length, and form a right angle with each side of the body; the claw which terminates them is small, and suddenly curved downwards and inwards, so as to form an angle with the preceding joint. The other feet are short and slender. In many species the carapace is rugose above and covered with spines or tubercles, and the anterior limbs are spiny. In the male the abdominal segments are blended, so as to make only four or five distinct.

Figs. 3181 and 3182 represent the Lambrus longimanus. In this species the rostrum is minute and trifid; the carapace is spinose above, and armed at its edges with strong serrations. The anterior limbs are very long, and rough with irregular spines on the upper border, and dentilated on the exterior border. This remarkable crustacean is about an inch in length, that is, with respect to the carapace. It is a native of the coasts of Pondicherry, Amboyna, &c.

The restricted genus Parthenope is distinguished principally by the disposition of the external antennæ, of which the basal joint is not soldered to the neighbouring parts. In all essentials it agrees with Lambrus; see Cuvier, 'Règne Animal,' vol. iv. p. 56.

As now restricted, the genus Parthenope contains only one species, viz., Parthenope horrida, Fig. 3183. In this very singular crustacean the carapace is pentagonal, wider than it is long, strongly embossed and tuberculous above; the rostrum is short and angular, and armed below with a strong tooth between the antennæ. The lateral borders of the carapace are armed with bold spines. The anterior limbs are very large and robust, of unequal size, and covered with great spiny tubercles; the claws are compressed. The succeeding limbs are armed with very large spines, exceedingly sharp, and disposed in two rows below and one above. This species is found in the Indian and Atlantic Oceans.

To the genus Parthenope succeeds the genus Cryptopodia, which appears to be a form intermediate between Lambrus and Œthra. The carapace is slightly tumid, and in the form of a triangle, which is very wide, very short, and rounded at the base; it is nearly twice as wide as it is long, but this great width does not depend on that of the body itself, but is due to the existence of the lamellar prolongation which surrounds the three posterior fourths of the dorsal buckler: behind, this prolongation extends very far beyond the insertion of the abdomen; but it is especially considerable on the lateral parts, for there it forms an enormous vault on each side, which completely hides the four last pairs of feet. Rostrum triangular, horizontal, and rather advanced. Eyes very small and completely retractile. Internal antennæ like those of Œthra; their first joint quadrilateral and flat; the second rather longer, and reaching to the front; the third lodged nearly entirely in the slit which exists between the front and the internal angle of the lower orbital border; the terminal stem which thus springs from the internal canthus of the eyes is very short. First pair of limbs very large and nearly prismatic; in direction and form nearly the same as in Lambrus. Four last pairs very small, and nearly of the same length; they scarcely reach beyond the vault which covers them. The abdomen in the female consists of seven joints.

Figs. 3184 and 3185 represent the Cryptopodia fornicata, so called from the vaulted (fornicata) expansion of the carapace over the posterior limbs. Fig. 3184 shows the under surface of this crab; Fig. 3185, the upper surface. It is a native of the Indian Ocean. The carapace is smooth above, and dentilated on its borders. The rostrum is entire, and as long as it is wide; the anterior feet are about half as long as the carapace, with the third joint dilated very much, posteriorly, and armed with spines on the anterior border. The posterior pairs of limbs are furnished, both above and below, with a dentilated crest along the third joint.

This species is the Parthenope fornicata of Fabricius; it is regarded by Latreille as forming a subgenus under Œthra: see Cuvier's 'Règne Animal,' vol. iv. p. 67. Œthra is doubtless closely allied to Calappa, which Latreille places in his group of Cryptopodia, an arrangement which we think very natural, but which differs from that of Milne Edwards, who associates together the Cryptopoda orbiculata, and Notopods of Latreille, as tribes of a group to which he gives the name of Oxystoma, and which he divides into—1. Leucosians; 2. Calappeans (Cryptopods); 3. Corystians (orbiculata), and Dorippians (Notopods). The Leucosians form part of the Orbiculata of Cuvier, and approximate to the Parthenopeans.

The group Oxystoma, as founded by Milne Edwards, presents the following general characters, to which indeed others might be added, but which the general reader would not appreciate. The carapace is generally more or less circular; the eyes are ordinarily small; the antennæ are variable; the buccal frame triangular, to which the external jaw-feet are adapted. The anterior limbs are almost always short.

In the Leucosians, the carapace is in general circular, presenting anteriorly a rather strong projection, at the extremity of which are often found the front and the orbits. The front is narrow, and the orbital cavities very small and nearly circular. The internal antennæ bend back, generally transversely or obliquely, under the front. The external antennæ, which are inserted in a narrow but deep notch of the internal orbitary angle, are nearly rudimentary. The buccal frame is in general regularly triangular, and the external jaw-feet of the same form do not show uncovered the stemlet, which supports their third joint. The palp or lateral branch of these organs is very large, and their base is distant from that of the anterior limbs. The apertures for the admission of water to the branchiæ are in the form of two canals. The number of abdominal articulations is three or four. Under this tribe are arranged the genera Arcania, Philyra, Myra, Ilia, Guaia, Leucosia, Persephona, Nursia, Ebalia, Oreophorus, Iphis, and Ixa.

Referring to our pictorial specimens, we perceive one of the genus Persephona.

In this form the anterior limbs are large and strong; the carapace is dilated on each side with the front advanced; the great joint of the abdomen of the male is composed of three pieces soldered together.

Fig. 3186 represents the Persephona Latreillii; the shell is covered with granulations, and presents on its hinder margin three recurved spines. The arms are tuberculous. Length three inches and a half. Its locality is unknown.

The Calappians are a remarkable tribe of crustaceans, and Cuvier has well named them Cryptopods, from the precise manner in which they are able to conceal their limbs; the four posterior pairs they withdraw close under a vaulted shield formed by the carapace, while the anterior pair are folded; and so nicely are the joints adjusted to each other, and the whole to the anterior margin of the carapace, that the expanse of the upper surface seems one uniform undivided piece. We never observe these animals without thinking of the box-tortoises, which shut themselves up within their shells, nor do we think the analogy overstrained.

We have already alluded to the Parthenope fornicata as an intermediate form between these crustaceans and Lambrus, &c.

In the Calappians the carapace is sometimes circular, sometimes widened, but always more or less convex. The front is of moderate width, and the lateral borders of the carapace delicate and more or less dentilated. The external antennæ are small, but very distinct. The first pair of limbs are strong, compressed, and curved so as to apply themselves against the buccal region, and armed above with a more or less elevated crest. The respiratory apertures are disposed as usual. In the restricted genus Calappa the antennæ resemble those of the ordinary crab (Cancer). The third articulation of jaw-feet, or pedipalpi, is terminated by a sort of pointed hook. The Chelæ are equal, very large, and compressed; their upper edge is elevated, notched or crested; they are so formed as to fit exactly to the external border of the carapace, so as to cover the entire region of the mouth: the rest of the limbs are short and simple. The carapace is short, convex, wider posteriorly than anteriorly, and forming behind a vaulted shield under which the posterior limbs are hidden, when the animal is in a state of repose or threatened by enemies. The eyes are mounted on short pedicles and approximate together. The Calappæ are called Migranes, Coqs de mer, and Crabes honteux, by the French; they are very extensively spread; they inhabit the seas of India, Australia, South America, the Mediterranean, &c.

Fig. 3187 represents the Calappa tuberculata, a native of the Mediterranean, and found in tolerable abundance in the fissures of rocks near Nice, where they reach to the depth of near ninety feet. According to Risso, the females deposit their eggs in the summer.

The carapace of this species is verrucose, and marked with four longitudinal furrows. On each side, anterior to the dilated part, are three teeth, very short and obtuse; these are followed by four others on the borders of the enlarged part, strong and pointed; there are two smaller teeth behind. The general colour is flesh-red, sprinkled with spots of carmine—some are of a pale rose-colour, with the terminal joint of their limbs brown; length nearly four inches.

Referring to Fig. 3187, *a* represents the crab, with the limbs exserted; *b*, the right chela, in which the singular form of the terminal pincers is well displayed.

The genus Œthra forms exclusively the Cryptopod cancerian tribe of Milne Edwards, but not, as we have seen, of Latreille. The latter naturalist consequently regards it as intimately allied to Calappa, from which he says it differs by the great flatness of the carapace; by the chelæ, which are not raised perpendicularly, and do not cover the front of the body; and by the almost square form of the third joint of the external pedipalpi. Mr. Milne Edwards considers the genus Œthra as approximate in organization to the ordinary Crabs or Cancerians, and that it has some affinity with the genus Cryptopodia, belonging to the family of the Oxyrhynchi, not, however, without some degree of affinity to Calappa.

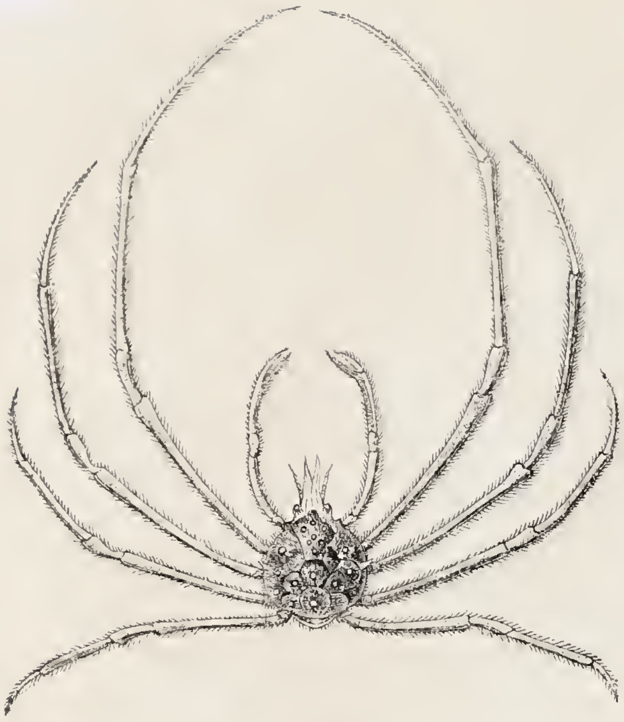
In the genus Œthra the whole surface of the body is rugged, and appears as if eroded. The carapace is a third wider than it is long, oval, strongly knobbed above, and with the lateral borders strongly dentilated and a little curved upwards. Front entire, and a little more projecting in the middle than on the sides. The eyes are very small; the orbits nearly circular, their upper border with two small fissures, and the lower border separated from the front by a very large gap. Abdomen with seven segments in the female, and five only in the male.

The species of this genus are distributed in the Indian and African Seas.

Fig. 3188 represents the Œthra scruposa, a native of the seas of the Indian Archipelago. It is of a greenish colour, and measures from two to three inches in length. *a* is an external view of the right chela.

Another form, intermediate between the Calappians and the Cancerians, is presented by the genus Hepatus. In this form the carapace is large, convex, regularly arched anteriorly, strongly narrowed posteriorly; the hepatic regions are very large, and the branchial regions very small. The front is narrow, straight, rather projecting, and placed a good deal above the level of the lateral border of the carapace, which prolongs itself under the orbits to reach the sides of the buccal frame. The orbits are small, circular, and placed on the same level with the front. The internal antennæ are somewhat apart, and are bent back very obliquely under the front. The external antennæ occupy the internal angle of the orbits, which they separate from the antennary pits; their basilary joint is narrow, but rather long; the second is, on the contrary, small, and their terminal stem is nearly rudimentary. The abdomen is divided into seven joints in both sexes.

The species belonging to the genus Hepatus are limited in number, two only being, we believe, at present recognised; both belong to the American Seas. Of these the Hepatus chilensis is found on the coast of Valparaiso; the other, Hepatus fasciatus (Calappa angustata, Fabr.; Cancer princeps, Herbst), is found in the seas of the Antilles, and on some of the coasts of North America. Fig. 3189 represents Hepatus fasciatus. This species is about the size of a moderate crab; its shell is yellowish, dotted with red; the margins of the carapace are finely crenulated. The limbs are banded with red.

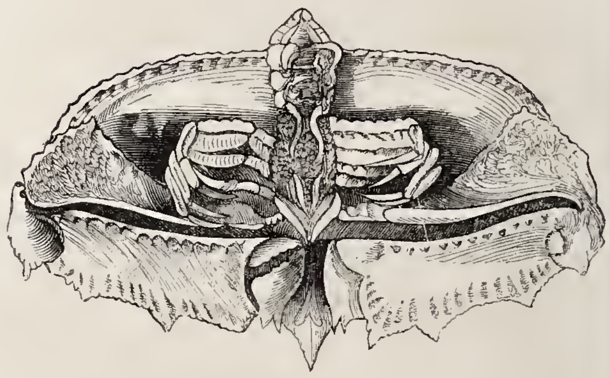


3177.—Egeria Indica.

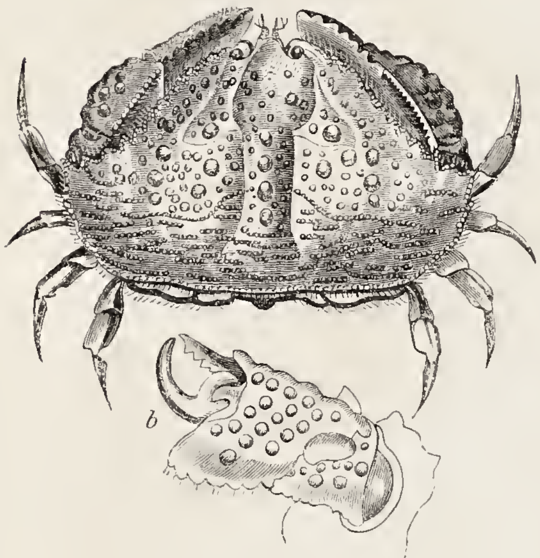
3173.—Halimus Aries.

3189.—Hepatus fasciatus.

3175.—Epialtus tuberculatus.

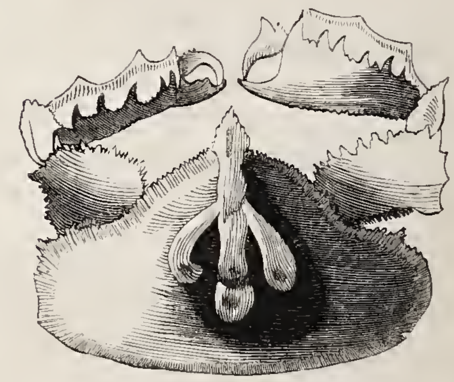


3184.—Cryptopodia fornicata. Under Surface.



3187.—Calappa tuberculata.

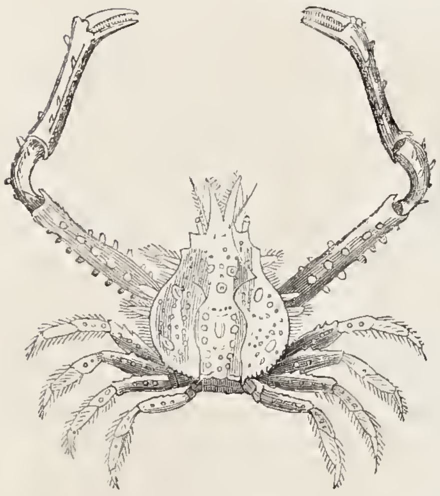
3176.—Leucippa pentagona.



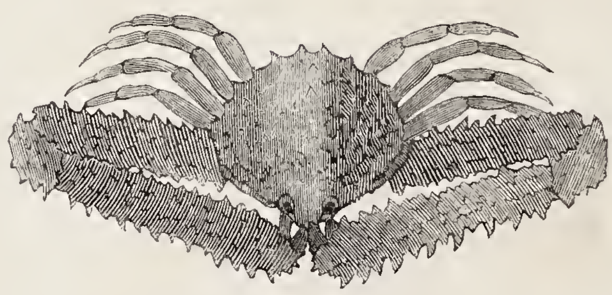
3185.—Cryptopodia fornicata. Upper Surface.

3179.—Euryonome aspera.

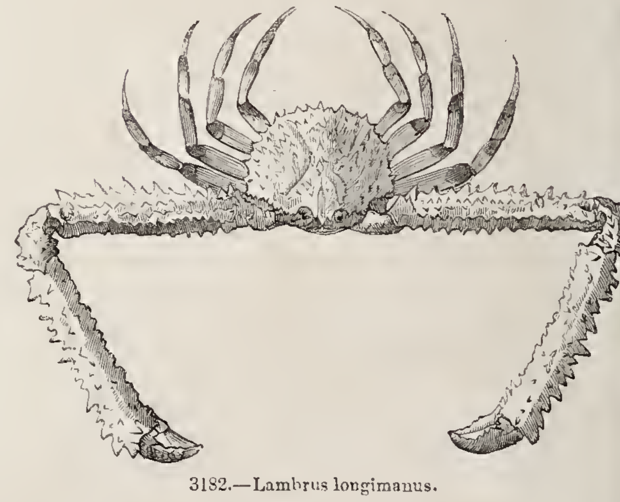
3178.—Eumedonus niger.



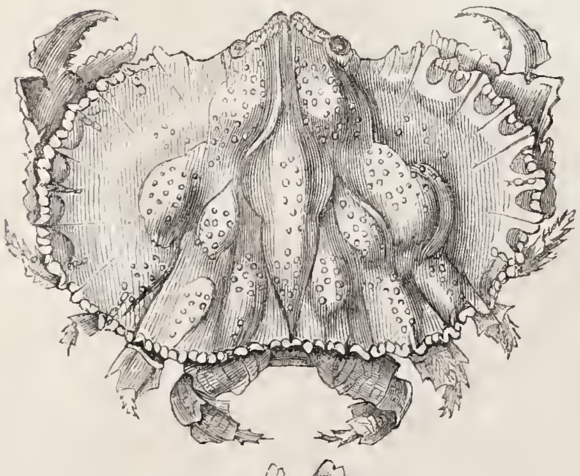
3180.—Euryonome aspera.



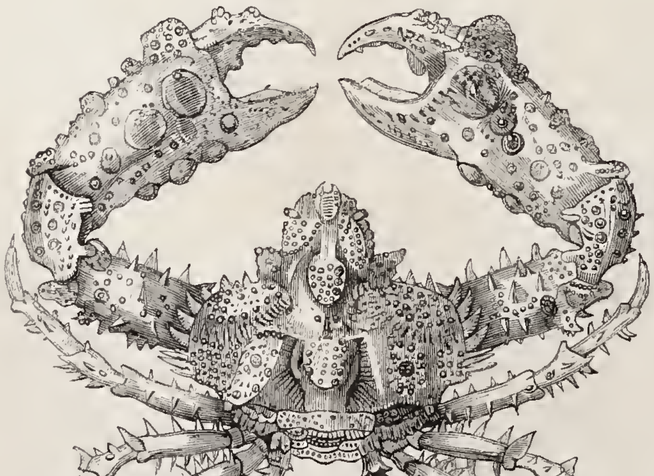
3181.—Lambrus longimanus.



3182.—Lambrus longimanus.

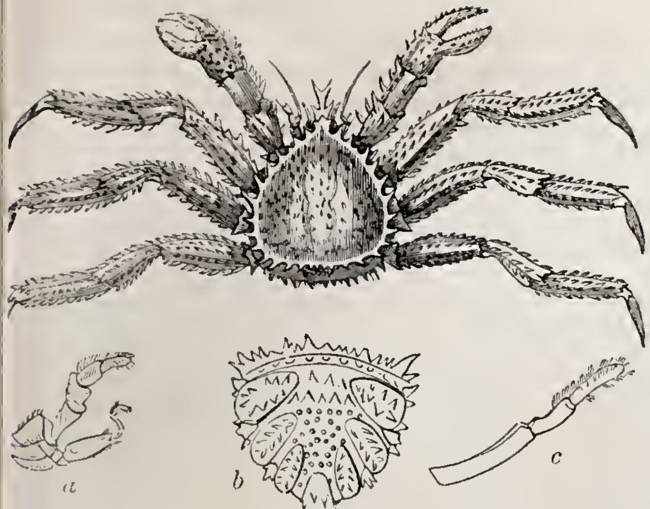


3188.—Œthra scruposa.

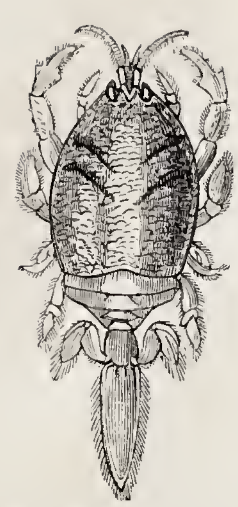


3183.—Parthenope horrida.

3186.—Persephona Latreillii.



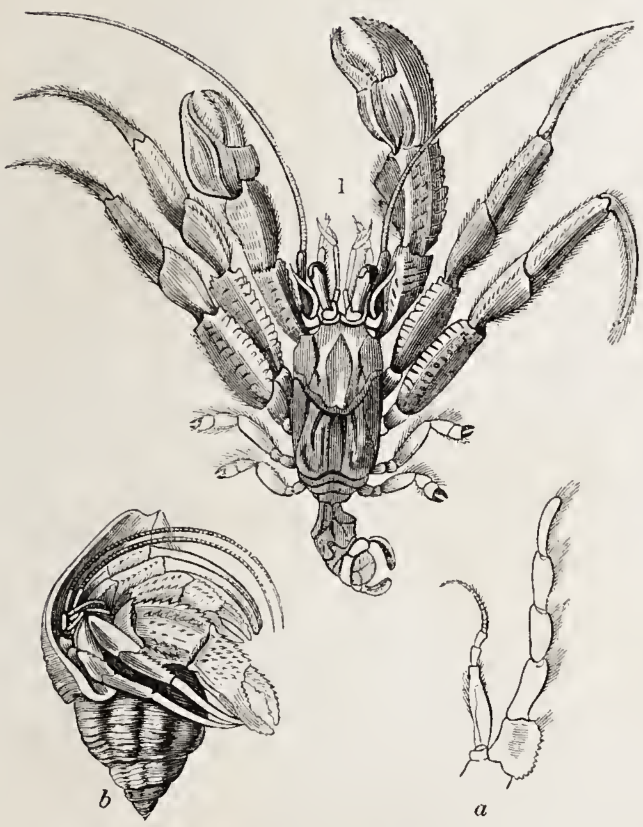
3191.—Lithodes arctica; Female.



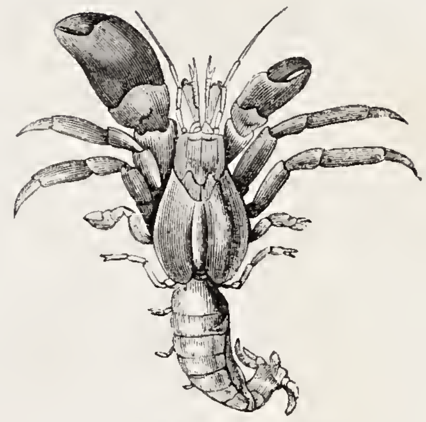
3195 —Remipes testudinarius.

3194.—Albunea symnista.

3193.—Pactolus Boscii.

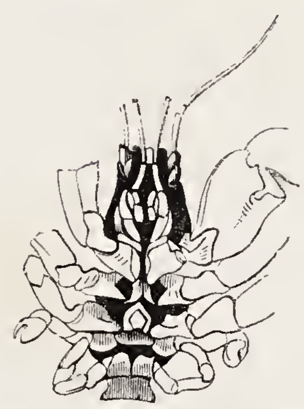


3197.—Pagurus Bernhardus.

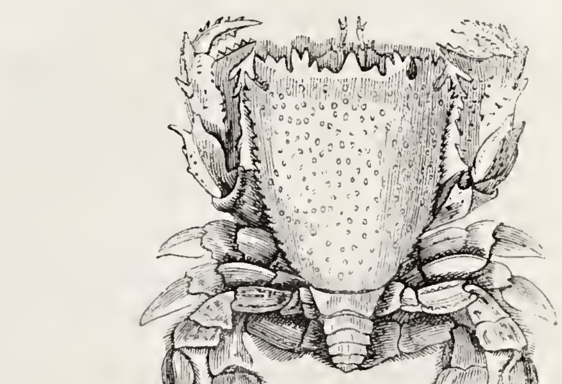


3199.—Pagurus Chilensis.

3198 —Pagurus deformis.



3200.—Under Side of Thorax of Cenobita.



3192.—Ranina dentata.

3196.—Hippa eremita.

3190.—Homola spinifrons.

To the Corystians M. Milne Edwards refers several genera, as Atelecyclus, Thia, Corystes, &c. To the Dorippians he refers Dorippe, Ethusa, &c.

The genera Thia, Dorippe, Ethusa, &c. have already been illustrated; for in the foregoing sketch of the Brachyurous Crustacea, we have not bound ourselves to the selection of any system, out of the many drawn up by various zoologists; our aim has been rather to give a general view of the leading characters of the Crustacea, and of the principal variations of form which obtain among them, than to elucidate any theoretic arrangement. As, however, the celebrated 'Règne Animal' of Cuvier is that to which most beginners in the study of zoology apply, we may say that in the fourth volume of that work Latreille divides the Brachyura into—i. *Pinnifeda*. Examples: Matutor, Polybius, Podophthalmus, Portunus, &c. ii. *Arcuata*. Examples: Cancer, Xantho, Thia, Hepatus, &c. iii. *Quadrilatera*. Examples: Eriphia, Pilumnus, Thelphusa, Gonoplax, Gelasimus, Ocypoda, Pinnotheres, Uca, Gecarcinus, Grapsus, &c. iv. *Orbiculata*. Examples: Corystes, Leucosia, Persephone, &c. v. *Trigona*. Examples: Maia, Parthenope, Mithrax, Euryonome, Acanthonyx, Micippa, Stenocinops, Camposcia, Halimus, Hyas, Doclæa, Maelus, Stenorhynchus, &c. vi. *Cryptopoda*. Examples: Calappa, Œthra. vii. *Notopoda*. Examples: Homola, Dorippe, Dromia, Ranina, &c.

In the arrangement of this writer there is no section termed Anomoura, or Anomura, which is that upon which we shall next enter.

SECTION ANOMOURA, or ANOMURA.

(Decapod Crustaceans with a development of the abdominal region intermediate between the Brachyura and the Macrura, and with the posterior limbs presenting certain modifications.) This section, as established by Milne Edwards, contains several forms which Latreille assigns to his Notopod Brachyura, as Homola, Ranina, &c., which present as it were the links of union between the Brachyura and the Anomura; while, on the other side, Birgus, Porcellana, Œglea, and Galathea link the latter to the Macrura.

The genera Homola, Lithodes, and Lomis, form a small group, having the carapace spiny, and furnished anteriorly with a rostrum. The internal antennæ are incapable of being bent back upon the front; the jaw-feet are pediform; the anterior limbs are furnished with claws; the second, third, and fourth pairs are very long, the fifth pair are very short, and of no service in progression.

In the genus Homola the carapace is longer than wide, and nearly quadrilateral; the front is narrow, and advances to form a small rostrum; the orbits are incomplete; the external antennæ rather long. The limbs are very long; the fifth pair are raised upon the back, and terminate in subcheliform holders. The abdomen consists of seven segments, and in the female the first segment carries a pair of short appendages, differing from those of the four succeeding segments, which are as in the Brachyura.

We select as an example the Homola spinifrons, Fig. 3190, found in the Mediterranean. It is about an inch and a half in length, and covered with yellow hairs. *a*, the left external jaw-foot.

In the genus Lithodes the carapace is heart-shaped, and the last thoracic ring is not soldered to the preceding, but free and even moveable. The fifth pair of limbs are extremely small, and bent back in the interior of the branchial cavities. The abdomen is large and triangular. The rostrum is moderate.

The Lithodes arctica (Fig. 3191) is a native of the Arctic Seas. It measures about five inches in length, and is of a reddish yellow colour. *a*, the left external jaw-foot; *b*, the abdomen; *c*, a foot of the fifth pair.

With respect to the genus Lomis, it is founded by Milne Edwards on a small crustacean supposed to be from the Australasian Seas; of its habits nothing is ascertained.

Another small group is represented by the genus Ranina. It is characterized by the carapace being convex laterally, and gradually narrowed posteriorly; the ocular peduncles are lodged in the orbits, but are bent, and composed of three moveable pieces. The anterior limbs are very much compressed, and the remainder are flattened and wide, and terminate in swimming paddles.

Fig. 3192 represents the Ranina dentata: *a*, seen from above; *b*, from below. It is a native of the Indian Seas. Though from the form of the limbs of this crustacean we should infer almost exclusively aquatic habits, yet Rumphius informs us that it comes to land, and creeps even to the tops of houses. Another group is represented by the genus Pactolus, in which we find the anterior limbs terminated with a simple hooked point, instead of a claw; the two posterior pair are furnished at the end with pincers. The carapace is elongated, and is produced anteriorly into a long slender rostrum, at the base of which are the large projecting eyes.

The only species, Paetolus Boscii (Fig. 3193), is of small size, measuring about eight lines, including the rostrum, which is spiny. The carapace is of a brownish colour; the limbs varied with red and white. Its country is unknown.

We now advance to a group or small tribe called Hippians by Milne Edwards; which he says are especially framed for burrowing in the sand, and consequently present extraordinary forms. The carapace is longer than it is wide, and very convex transversely, presenting always on each side a great lamellar prolongation which more or less covers the base of the feet; it is truncated posteriorly and appears to be continuous with the anterior portion of the abdomen, which is very wide and lamellar laterally. One pair of antennæ is always very long. The jaw-feet are peculiarly modified, having neither flagrum or palp. The limbs are imperfectly extensile; the first pair have a simple termination, being what is termed monodactylus or subcheliform. The succeeding two or three pairs are terminated by a lamellar joint proper for burrowing; the posterior feet are filiform, semimembranous, curved forwards, and hidden beneath the base of the carapace and the preceding feet. The penultimate ring of the abdomen is always furnished with a pair of false feet, terminated with two ciliated blades or laminæ of a more or less oval form. To this group belong the genera Albunea, Remipes, and Hippia.

In Albunea the ocular peduncles are large and lamellar, but the eyes are very small; the internal antennæ are large and elongated, multiarticulate, and ciliated; the external antennæ are short. The external jaw-feet are more or less pediform. The limbs are short, the first pair are subcheliform, and terminate in a large moveable hook, applying its point to the expanded edge of the joint on which it is articulated. The three following pairs terminate in a joint, somewhat resembling a broad sickle. The last pair of feet are filiform, and hidden. The first ring of the abdomen is very small, and fitted into a notch of the carapace. The second is very large, with a lateral expansion on each side abutting upon the carapace. The third and fourth segments diminish progressively: the remainder, that is the fifth, sixth, and seventh, are very narrow, and the sixth supports a pair of bifid false feet, for the purpose of swimming.

As an example of this genus we select the Albunea symnista (Fig. 3194). It is of small size, and inhabits the seas of Asia.

In the genus Remipes the carapace is nearly of a regular oval, and convex. The anterior limbs are long, and the last joint is slightly flattened, and incapable of being bent so as to antagonize with the preceding; the two following pairs of limbs are terminated with pointed paddles; the fourth pair are held by a small joint; the fifth pair are slender, long, and membranous, and bent upon the lateral prolongation of the carapace. The abdomen is large; the sixth ring carries a pair of false swimming feet; the seventh ring is in the form of a pointed paddle.

Fig. 3195 represents the Remipes testudinarius, a small species from the coasts of New Holland. The genus Hippa is very closely allied to the preceding. The external antennæ are terminated by a long and multiarticulate filament, but are seldom very visible, being ordinarily bent down and hidden between the mouth and external jaw-feet. The limbs are all short, and terminating in paddle-like laminæ. The abdomen closely resembles the same part in Remipes.

Fig. 3196 represents the Hippa emerita, from the coasts of Brazil; it seldom much exceeds an inch in length.

We now come to the group called Pagurians, of which the genus Pagurus must be considered as the type. Few have visited the shores of our island without having noticed the Paguri, Soldier-crabs, or Hermit-crabs, as they are called, peeping out of the old turbinate shells, in which they have taken up their abode, and of which they guard the entrance with great resolution. In the true Paguri, the abdominal portion is destitute of defensive armour, or presents only a few isolated calcareous patches; and it is from being thus as it were partially defenceless, that they are obliged to resort to artificial means of protection. Consequently they avail themselves of such shells as are fitted to their size, and entering them backwards, lodge the abdominal segments in safety, and are prepared with their claws to defend the gateway of their castle. As they increase in size they change their quarters for others more spacious and better suited to their necessities.

Thus housed, the Paguri are retained in the shell by the aid of the posterior limbs, and a pair of appendages at the end of the abdomen.

If we take the common Hermit-crabs of our coasts (Pagurus Bernhardus), we shall find that one only of its pincer claws is greatly developed, generally the right; and this, with the first two pairs of locomotive limbs, which are long, are bent over the columellar edge of the shell, and protrude externally. The two next pairs of limbs are very short, and are applied within the shell to the columellar fold, so that by pushing they force the body farther into its recess. The caudal holders, which are as rough as a file, are applied in the same manner, but more deeply within the shell; and in some species the abdomen is furnished with rows of suckers, by which the hold of the Pagurus must be greatly strengthened.

Here then, secure, the animal peers out in quest of prey; and dragging his castle after him, traverses the shore, withdrawing himself on the appearance of danger; yet when assaulted, ready, as we have often seen, to engage in a spirited contest. With respect to other parts of their structure we may add that the eyes are directed forwards, and not retractile; the external antennæ end in a long multiarticulate filament.

An allied genus, termed Cenobita, differs in many points from Pagurus; which in general habits and economy it otherwise closely resembles. The Hermit-crabs are widely distributed, and were known to the ancients. They haunt low flat shores and shallows, where, when the water is clear, they may be seen creeping about, making an irregular progress. Like other crustaceans generally they feed on small marine animals, and dead animal matters which chance throws within their reach. They have the senses of sight and smell very acute; and the antennæ are very susceptible.

It would appear that there are certain species of Hermit-crabs, which are as terrestrial in their habits as the violet crabs or other land species, and that some even feed on fruits.

Of such crabs Mr. Broderip received several specimens from Mr. De la Beche; they were not all of the same species, one was Pagurus (Cenobita) Diogenes; the other somewhat resembled Pagurus Prideaux (Leach). Of the first, there "were forty-two of various sizes, housed in the following marine-shells, which were in every instance well adapted to the bulk of the inhabitant. Two were lodged in Turbo Pica; two in a Natica; one in Bulla striata; there were eight in Fasciolaria tulipa, and twenty-nine in Pyrula melongena. Of the latter species of Pagurus, the common soldier of Browne, one was housed in Fasciolaria tulipa, and nine in Pyrula melongena. The shells chosen by the last were large in proportion to the bulk of the animal; so large indeed, that some of the Paguri were scarcely visible."

To these Paguri the following communication to Mr. Broderip from Mr. De la Beche refers; it is dated August 1, 1838:—

"When I was in Jamaica, about three years since, some of the persons on my estate at Halse Hill brought me specimens of Paguri, which they said they had obtained from a savannah distant about a quarter of a mile from the house. This savannah is a plain formed of what I have elsewhere ('Geol. Trans.' vol. ii., N. S.) termed savannah sandstone and conglomerate. It is very dry and covered for the most part with logwood, green ebony, lignum vitæ, the cashew-tree, and here and there with patches of grass and other plants. After heavy rains the surface of the ground is nearly covered with herbage; but after dry weather a considerable portion of the soil is exposed. The savannah, which is of great extent (my portion consists of at least two thousand acres), is about thirty feet above the Rio Minho, which runs round the border of it, and about two hundred feet above the level of the sea, from which it is distant at least ten miles. The tide only penetrates just within the mouth of the river, and rises about eleven inches in the height of the springs, so that there is not even brackish water at a nearer point than ten miles. When the Paguri were brought me they were alive, and I observed that they were housed in marine shells, and at first thought they must have been brought from the sea. Upon inquiring, however, I found that these animals, under the name of soldiers, were frequently taken alive for food in the savannah, to which I immediately proceeded. On its northern side, and at its junction with the hill that rises above it, I found in the little hollows of the white limestone several of these Paguri, all in marine shells, and in full health and activity. I afterwards learned that they were by no means uncommon in such situations all over the island. When I saw them there had been a good deal of wet weather. They were in moist places, but there were no pools of water." Another gentleman, who resided some time in the West Indies, informed Mr. Broderip that he had seen the Pagurus (Cenobita) Diogenes about his house when he lived at Port Henderson, and that he had observed them about the houses in Spanish Town, a place about six miles from the sea. Mr. Broderip was also informed that Westmoreland swarmed with them. (See 'Zool. Journal,' vol. iv.)

To the terrestrial habits of these crabs many writers have made express allusion. Sloane, speaking of the "Soldier," apparently Cenobita Diogenes, says, "This small lobster or crab differs in very little from the European soldier or hermit-crab. It hath two large forked claws like those of an ordinary lobster, one of which is bigger than the other, both rounded, more tumid, less prickly, and of a paler red than that of Europe. They fit themselves with any shell they find empty, whether it be of the land or sea, and cover themselves almost over in it, carrying it on their backs wherever they go, like a snail. It is not possible to believe how quick both the land-crabs and these soldier-crabs will run upon the least appearance of danger. Till they are turned up nothing appears but a dead shell, the mouth of which lies undermost, out of which some little part of the crab appears after it is taken up." ('Jamaica.') Sloane figures the crab in a species of Helix, or land shell, and we believe that one of these crabs in a Helix was living some time since in the Gardens of the Zool. Soc.

Catesby, in reference to the same species, which he figures in the shell of Turbo Pica, states that "they crawl very fast with their shell on their back, and at the approach of danger withdraw themselves within the shell, and, thrusting out the larger claw in a defensive posture, will pinch very hard whatever molests them. They frequent most those parts of sea-shores which are covered with trees and shrubs producing various wild fruits on which they subsist; though I have seen them feed on the fragments of fish and other animal substances cast on shore. They, being roasted in the shell, are esteemed delicate. I do not remember to have seen any of them go into the sea." ('Hist. Carolina.')

A writer in the old French Encyclopædia, who most probably takes his account from Du Tertre's Voyage, says, "There are in the isles of America Hermit-crabs, which are three or four inches in length. It is asserted that this animal comes once a year to the edge of the sea, to lay its eggs and change the shell; for it is alleged to quit the shell in which it is lodged, because, having increased in size during the year, it finds itself incommoded in its old shell. It therefore comes to the shore and seeks a new shell which may be convenient for it. As soon as it meets with one, it comes out of the old one and tries the new lodging; and if that suits it, it remains there, but it is often obliged to enter many shells, before it finds one proportioned to it. If it happens that two hermit-crabs stop before the same shell, a dispute arises, and the weakest yields to the strongest.

Like all other Crustacea, the hermit-crabs increase in size at the periods of exuviation, but whether this process takes place in the old shell or in a new one, or out of a shell altogether, we have no information. Certain it is, however, that the shell is changed as the growth of the animal may require.

Referring to our pictorial specimens, Fig. 3197 represents the common hermit-crab (Pagurus Bernhardus) of our coasts. The upper figure exhibits the animal out of its shell; *a*, the right jaw-foot; *b*, the animal in the shell. Of the great numbers of these crabs which we have seen, and of which several specimens are now before us, most have made the shell of the Whelk their habitation. The species of this form are very numerous; from many others we select as examples the Pagurus deformis, found on the shores of the Isle of France and the Seychelles (Fig. 3198); and the Pagurus Chilensis (Fig. 3199), a native of the coasts of Chile.

With respect to the allied genus Cenobita, the generic characters are laid down as follows:—The ocular peduncles are rather short, but large and compressed, so as to be nearly lamellar; the cornea occupies the terminal and external portion. The internal antennæ, inserted a little behind the external ones, are extremely large; their first joint, large at the base and cylindrical, reaches beyond the eyes, and has a second joint still longer; the third joint is rather longer than the second, and supports two terminal filaments, one of which is short and setiform, the other stout, rather long, and obtuse. The external antennæ are very much compressed, their peduncle is long, but does not reach the extremity of the second joint of the internal antennæ, and their palp is only represented by a small rudimentary tubercle. The external jaw-feet are pediform, short, nearly cylindrical, and devoid of teeth toward their base. The anterior feet are stout, unequal, and terminated by a short claw, which is compressed internally. The second and third pair are large, but present nothing remarkable; the fourth pair are nearly rudimentary, and their last joint has the form of a small tubercle, scarcely moveable; the fifth pair are formed as in Pagurus, except in the male, where their basilary joint presents a tubular prolongation more or less extended, at the extremity of which is the generative apparatus. The abdomen is membranous and rolled upon itself, as in the Paguri, but is shorter. In the female it has, on the left side, three rather large false oviferous feet fixed to the dorsal plates; farther backward is a fourth horny plate without any appendage. At the extremity of the abdomen is a dorsal horny segment, with a median lamina on its posterior border, and on each side an appendage, that of the right side being much the smallest; the form of these appendages is the same as in the Paguri. In the male all these abdominal appendages, with the exception of the terminal pair, are completely wanting; but dorsal horny plates indicate the division of the abdomen into rings.

Fig. 3200 represents the under surface of the thorax of Cenobita.

The Cenobites are all natives of the warmer regions; we have already alluded to the Cenobita Diogenes. It is represented at Fig. 3201: *a* is the animal partially out of shell, so as to show the arrangement of the limbs, and of these the fourth pair, with their file-like terminations for firm application to the smooth columella, are very conspicuous; *b* is the large claw; *c*, Cenobite housed completely within the shell, showing how the entrance is guarded by the limbs, and especially by the great claw, which acts as a sort of operculum, and is at the same time ready for active service in case of emergency. The shell in which the Cenobite is housed is the Turbo Pica. The Cenobita Diogenes is a native of the Antilles.

From the genus Pagurus has been separated by M. Milne Edwards a form to which he has given the name of Cancellus, but of which little is known. He himself, as he informs us, had only examined the male of the species on which he founded the genus, and of which it is the only ascertained example. The abdomen, instead of being rolled upon itself and terminating in a sort of shapeless tail, is perfectly symmetrical; the appendages of the penultimate segment have the same form as in the Paguri, but are similar on each side, and there is no other appendage adhering to the abdomen between this segment and the thorax. Fig. 3202 represents the Cancellus typus.

The following characters are enumerated by Milne Edwards:—Ocular peduncles slender, reaching beyond the peduncle of the external antennæ for nearly one-half of their length, but nevertheless shorter than the anterior border of the carapace; cornea transparent, very small, and without any notch on its superior border. External antennæ very short, hardly more than twice as long as the ocular peduncles. Anterior feet equal, and depressed above; on the upper edge of the claw-joint a dentilated crest, which is united to a rounded longitudinal elevation on the external surface, so as to form a pyramid of three faces on the carpus; external surface of the claw-joint a little warty; pincers very short. Second pair of feet much stouter and longer than the third, and furnished with a crest which extends from the middle of the third joint to their extremity, in describing a regular curve, the convexity of which is outwards; the upper extremity of this crest is elevated, like that of the anterior feet, pyramidically, and corresponds exactly to the extremity of the ocular peduncles, when the feet are directed forwards. Tarsi very short and rather stout. Third pair of feet much compressed. Basilary joint of the posterior feet large and squamiform. Abdomen of the male short, large, furnished above with very narrow transverse plates, which have no appendages, and terminated by a pair of appendages as in the other Pagurians, but symmetrical, and by a median lamina equally symmetrical.

Leaving the Pagurians, we immediately advance to a very singular crustacean, the type of the genus Birgus, remarkable for its manners and general habits.

The characters of the genus Birgo are detailed nearly as follows by M. Milne Edwards ('Hist. Nat. des Crustacés'). The carapace is terminated anteriorly by a projecting rostrum, and is of considerable extent, forming a convex shield over the branchiæ on each side. The ocular peduncles are stout, rounded, and of moderate length. The internal antennæ have the same conformation as in the Cenobites, except that their basilary joint is still more elongated. The disposition of the external antennæ and of the external jaw-feet is also entirely the same as in the last-named Pagurians. The anterior feet are stout, rounded, and of moderate length; the two succeeding pairs are terminated by a stout cylindrical joint; and the fourth pair, which are shorter than the preceding, but not elevated above them, are provided with a cheliform hand, the two fingers of which are long and cylindrical; the posterior feet, which are very short and cylindrical, are elevated under the lateral parts of the carapace, and terminated by a very obtuse rudimentary pincer. The abdomen is very large, and covered above by a small horny band, followed by four great corneo-calcareous plates, which occupy its whole width, and over-ride each other, as in the Macrurous Crustaceans. On each side of these great segments are to be seen one or two horny pieces. In the female, the three first of these segments, that is to say, the second, third, and fourth rings, have on each side a great false foot formed by a small basilary piece and two great narrow and ciliated appendages; those members are wanting on the right side, and in the male no trace of them is perceptible. The whole of the inferior surface of the abdomen is membranous, except that towards its posterior part may be seen a small quadrilateral plate, which gives attachment to a second projecting plate, and has on each side an abdominal rudimentary false foot, composed of a basilary piece and two moveable tubercles, which recal the disposition of the appendages of the sixth abdominal ring of the Paguri, but which is symmetrical on both sides of the body. The terminal plate is rounded at the end, and represents the seventh abdominal ring.

The respiratory apparatus in Birgus presents very remarkable peculiarities of structure. The branchiæ are fourteen in number on each side of the body, and are fixed by a peduncle situated towards the middle of their internal surface. The respiratory cavity is very large, and the branchiæ only fill the tenth part of it; its vault is carpeted below by a delicate and epidermic membrane; but this soon disappears and leaves naked the skin, which is continued with that membrane, and covered by a multitude of vascular vegetations.

The Birgus Latro (Fig. 3203), Purse-crab, or Robber crab (Pagurus Latro, Fabr.; Cancer crummentatus, Rumphius), is a native of Amboyna and the neighbouring islands, and attains to a considerable size. In its habits it is terrestrial, inhabiting the fissures of rocks by day, and coming forth at night to seek for its food upon the beach. It appears to be frugivorous as well as carnivorous, and is reported to climb the cocoa-nut trees for the purpose of obtaining the fruit. To this account Linnæus, Herbst, and Cuvier refer, and it is no doubt based upon truth. The following extract from the 'Proceeds. Zool. Soc.' 1832, p. 17, may not be uninteresting:—"A specimen was exhibited of Birgus Latro, which had been presented to the Society by Mr. J. P. Vaughan, and Mr. Owen referred to the curious statement of Herbst that this crab climbs trees for the purpose of stealing cocoa-nuts; a statement partially confirmed by the fact, recorded by MM. Quoy and Gaimard, that individuals of this species were fed by them for many months on cocoa-nuts alone. A more ample confirmation, he remarked, was furnished by some observations communicated to him by Mr. Cuming, whose fine collection contained several specimens obtained in the islands of the South Pacific Ocean. They climb, Mr. Cuming states, a species of palm (Pandanus odoratissimus), and eat a small kind of cocoa-nut that grows thereon. They live at the roots of the trees, and not in holes in the rocks, and are a favourite food of the natives." To give an idea of the kind of palm these crabs are in the habit of climbing, we represent, at Fig. 3204, one of the Pandanus tribe, Freycinetia imbricata, with its fruit.

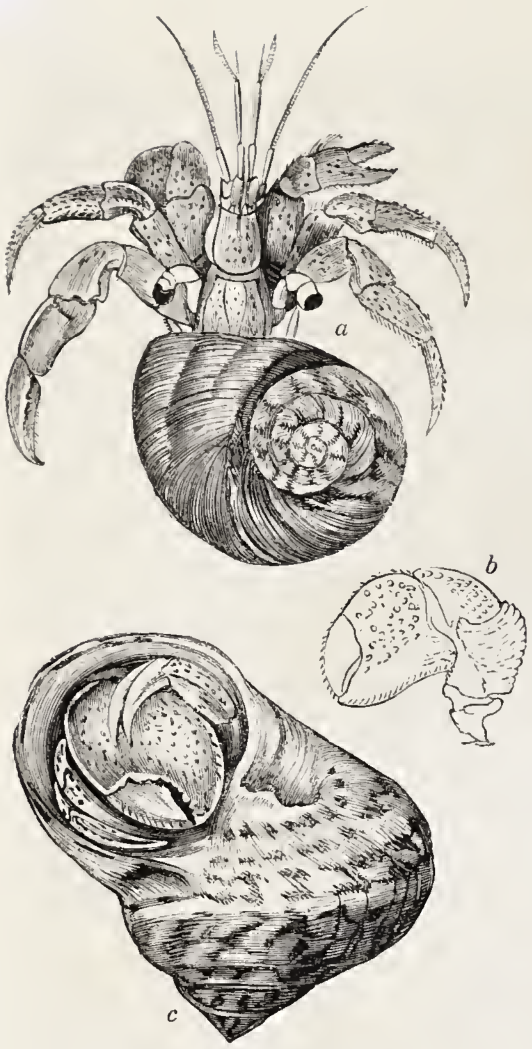
Mr. Cuming observed these crabs in great abundance at Lord Hood's Island, in the Pacific. When he met them in his road, they set themselves up in a threatening attitude, and then retreated backwards, making both at first and afterwards a great snapping with their pincers. Linnæus confounded this species with the land-crabs (Gecarcinus) of the West Indies, called during their moult "Crabes boursiers."

We now arrive at a small group, termed Porcellanians, consisting of Crustacea which have the port and aspect of the Brachyura, but in which the abdomen ends in a fan-like caudal fin; the abdomen itself is wide, but lamellar, and bent against the sternum. Fig. 3205 represents Porcellana platycheles; *a*, the tail unfolded. This crab is of small size, being scarcely three-quarters of an inch in length. It is a native of the coasts of France and England.

Another genus belonging to this tribe is Æglea, of which the Æglea lævis from the coast of Chile (Fig. 3206) is an example. It is about two inches in length.

A tribe closely allied to the Porcellanians is represented by the genus Galathea. The carapace is depressed and wide; the anterior limbs are large, the fifth pair very slender; the abdomen nearly as wide as the thorax, and longer, and terminates in a large fan-shaped lamelliform fan; false feet, five pairs in the male.

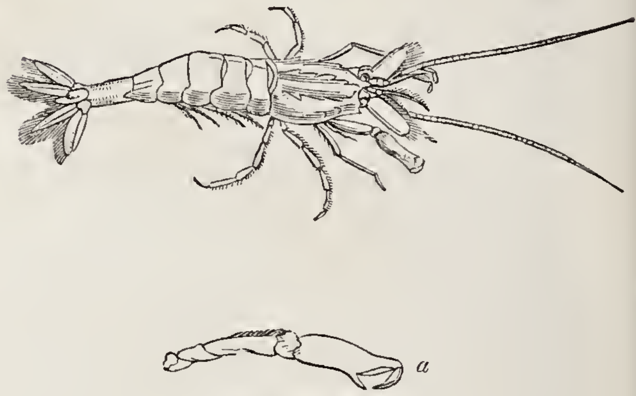
The Galathea strigosa (Fig. 3207), which we select as an example, is about five inches in length; its colour is reddish, with lines of blue on the carapace. The limbs are strongly spined, as is also the margin of the carapace. This species inhabits the Mediterranean and the Ocean.



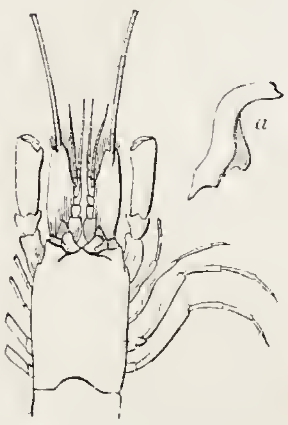
3201.—Cenobita Diogenes.

3204.—Freycinetia imbricata.

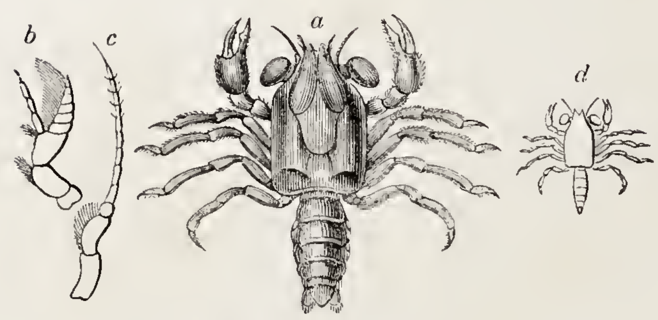
3203.—Birgus Latro.



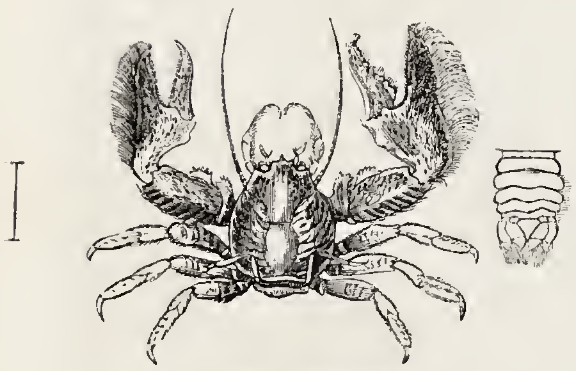
3211.—Egeon loricatus.



3210.—Details of Shrimp.

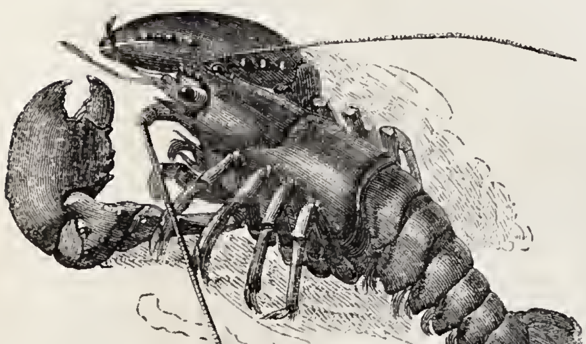


3208.—Megalopa mutica.

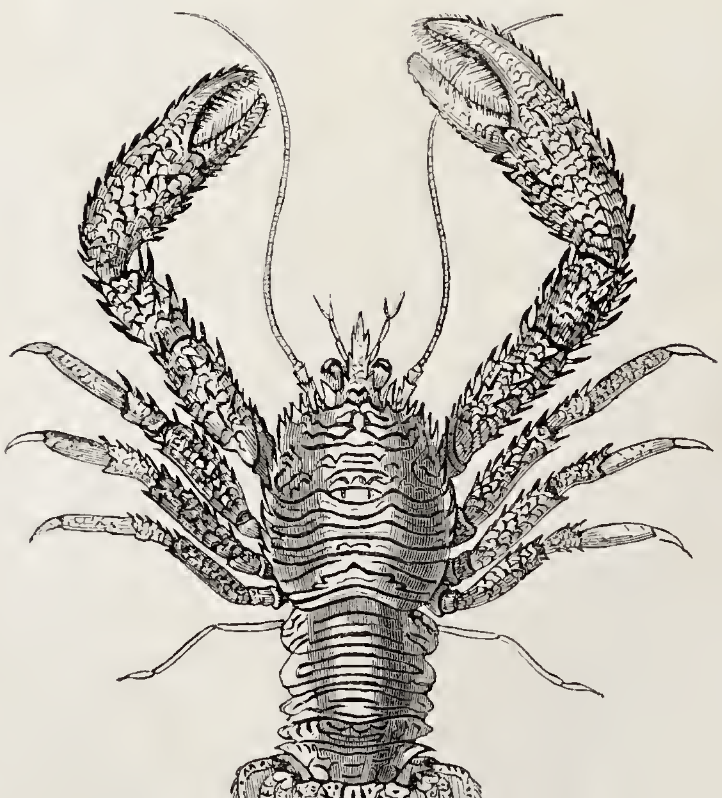


3205.—Porcellana platycheles.

3202.—Cancellus Typus.



3209.—Lobster.

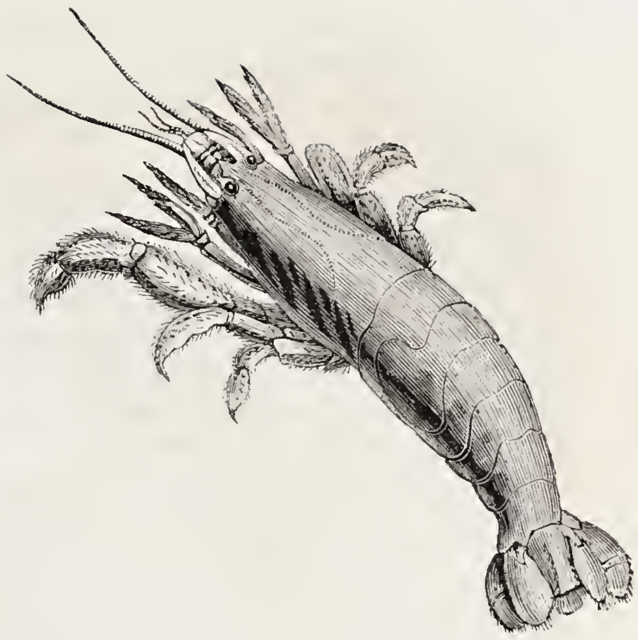


3207.—Galathea strigosa.

3206.—Æglea lævis.

3212.—Common Shrimp.

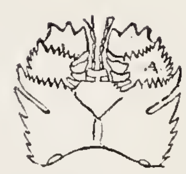
3215.—Prawn.



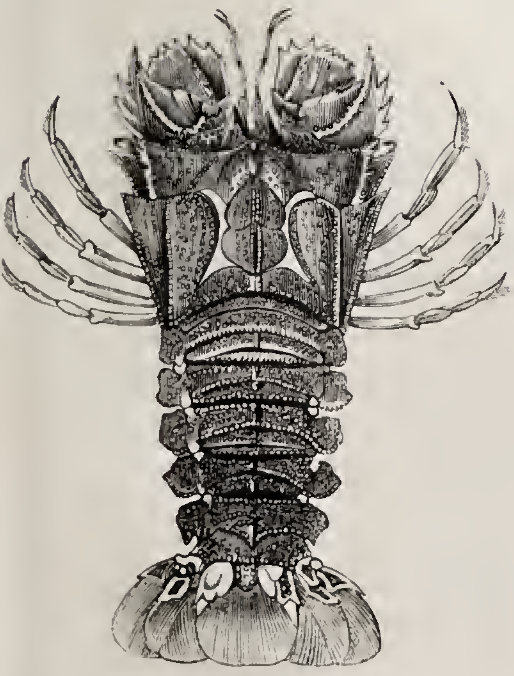
3214.—Atya scabra.

3216.—Jaw foot of Scyllarus.

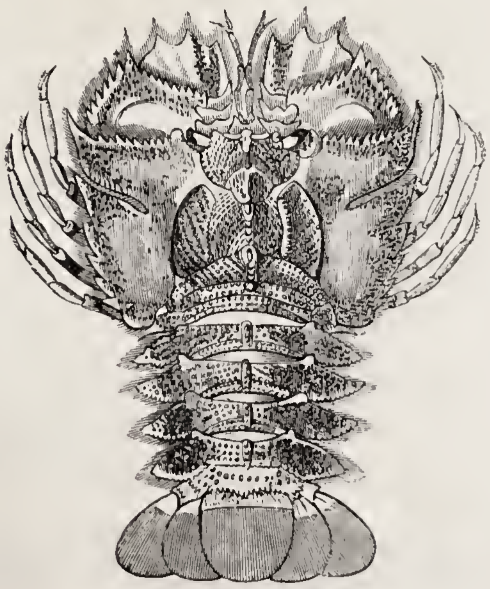
3213.—Young Shrimp-catcher.



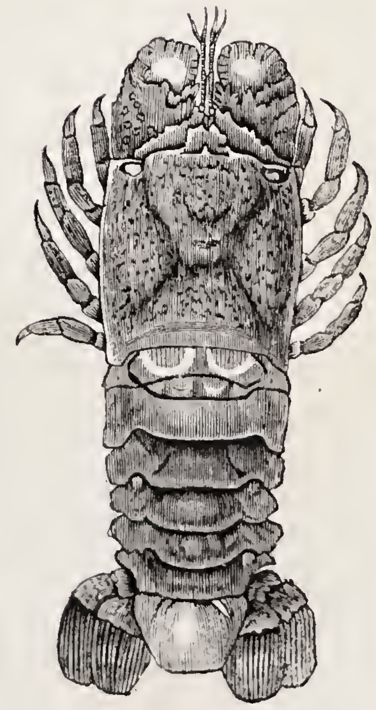
3219.—Carapace of Ibacus.



3218.—Thenus Orientalis.



3220.—Ibacus Peronii.



3217.—Scyllarus æquinoctialis.

SECTION MACRURA.

(Decapod Crustaceans with the abdominal segments well developed, and of which we may regard the lobster as the type.)

The genus of this section to which we shall turn, and to which the last genera of the Anomura appear in some respects to approximate, is one termed Megalopa by Dr. Leach. It contains a few small species remarkable for the comparative volume of the eyes, which are set on short peduncles. The abdomen is narrow and extended, with seven segments; false feet four pairs. The Megalopa mutica (Fig. 3208) is found at the mouth of the Loire; it is of a brown colour. *a* is the species magnified; *b*, internal antennæ; *c*, external antennæ; *d*, the animal of the natural size.

We may now pass to the genus Astacus, which contains the common lobster, Astacus marinus, and the River crayfish, Astacus fluviatilis, &c. Fig. 3209 represents the common lobster. We shall not attempt to enter into a detailed account of the form and structure of this well known species, so celebrated for its excellence as an article of diet, and for the change of colour it undergoes in boiling. This change, it may be remembered, served Butler in his 'Hudibras' for one of his humorous similes:—

> "Now, like a lobster boiled, the morn
> From black to red began to turn."

It is owing to the action of water at 212° Fahr. upon the bluish-black pigment secreted by the corium, and diffused through the substance of the tegumentary skeleton or armour, which it also secretes. Alcohol, æther, and the acids also produce the same effect.

The lobster is found in abundance in clear water, among submerged rocks, along various parts of our coast, and is captured nearly in the same manner as the crab. It is not only from our own shores that the markets are supplied with this delicacy; thousands are brought over from Norway, in a living state; five or six vessels in fact are constantly plying between the Thames and Norway, for this purpose alone. On entering the river, the lobsters are deposited in large wooden cases, properly perforated, and secured in a creek called Hole Haven, on the Essex side of the Thames, near the upper part of the Sea Reach, whence they are transmitted to Billingsgate according to the demand. Great numbers are also brought from Scotland. The consumption of lobsters in England is almost incalculable; but the vast destruction made is counterbalanced by an according increase. By a wise provision, the maintenance of the species is fully secured, so great is its fecundity. Dr. Basten says that he counted twelve thousand four hundred and forty-four eggs under the tail of one female lobster; and that this number was not the total amount.

One of the best narratives extant of the habits of the lobster is to be found in a letter from Mr. Travis, of Scarborough, to Mr. Pennant, dated the 25th of October, 1768. We select from it the following extracts:—

"We have vast numbers of fine lobsters on the rocks near our coast. The large ones are in general in their best season from the middle of October till the beginning of May. Many of the small ones, and some few of the larger sorts, are good all the summer. If they be four inches and a half long, or upwards, from the tip of the head to the end of the back shell, they are called sizeable lobsters. If only four inches, they are esteemed half-size, and when sold, two of them are reckoned for one of size. If they be under four inches, they are called pawks, and are not saleable to the carriers, though in reality they are in the summer months superior to the large ones in goodness. The pincers of one of the lobster's large claws are furnished with knobs, and those of the other claw are always serrated. With the former it keeps firm hold of the stalks of submarine plants, and with the latter it cuts and minces its food very dexterously. The knobbed, or numb claw, as the fishermen call it, is sometimes on the right and sometimes on the left, indifferently. It is more dangerous to be seized by them with the cutting claw than the other; but, in either case, the quickest way to get disengaged from the creature is to pluck off its claw. It seems peculiar to the lobster and crab, when their claws are pulled off, that they will grow again, but never so large as at first.

"The female or hen lobster does not cast her shell the same year that she deposits her ova, or, in the common phrase, is in berry. When the ova first appear under her tail, they are very small and extremely black; but they become, in succession, almost as large as ripe elder-berries before they are deposited, and turn of a dark brown colour, especially towards the end of the time of her depositing them. They continue full and depositing the ova in constant succession, as long as any of that black substance can be found in their body, which, when boiled, turns of a beautiful red colour, and is called their coral. Hen lobsters are found in berry at all times of the year, but chiefly in winter. It is a common mistake that a berried hen is always in perfection for the table. When her berries appear large and brownish, she will always be found exhausted, watery, and poor. Though the ova are cast at all times of the year, they seem only to come to life during the warm summer months of July and August. Great numbers of them may then be found, under the appearance of tadpoles, swimming about the little pools left by the tides among the rocks, and many also under their proper form, from half an inch to four inches in length.

"In casting their shells, it is hard to conceive how the lobster is able to draw the fish of their large claws out, leaving the shells entire and attached to the shell of their body; in which state they are constantly found. The fishermen say the lobster pines before casting, till the fish in its large claw is no thicker than the quill of a goose, which enables it to draw its parts through the joints and narrow passage near the trunk. The new shell is quite membranous at first, but hardens by degrees. Lobsters only grow in size while their shells are in their soft state. They are chosen for the table by their being heavy in proportion to their size, and by the hardness of their shells on their sides, which, when in perfection, will not yield to moderate pressure. Barnacles and other small shell-fish adhering to them are esteemed certain marks of superior goodness. Cock lobsters are in general better than the hens in winter; they are distinguished by the narrowness of their tails, and by their having a strong spine upon the centre of each of the transverse processes beneath the tail which support the four middle plates of their tails. The fish of a lobster's claw is more tender, delicate, and easy of digestion than that of the tail. Lobsters are not taken here in pots, as is usual where the water is deeper and more still than it is upon our coast. Our fishermen use a bag-net fixed to an iron hoop, about two feet in diameter, and suspended by three lines like a scale. The bait is commonly fish-guts tied to the bottom and middle of the net. They can take none in the daytime, except when the water is thick and opaque: they are commonly caught in the night; but even then it is not possible to take any when the sea has that luminous appearance which is supposed to proceed from the Nereis noctiluca. In summer the lobsters are found near the shore, and thence to about six fathoms' depth of water; in winter, they are seldom taken in less than twelve or fifteen fathoms. They are much more active and alert in warm weather than in cold. In the water they can run nimbly upon their legs or small claws, and, if alarmed, can spring tail foremost to a surprising distance as swift as a bird can fly. The fishermen can see them pass about thirty feet, and, by the swiftness of their motion, suppose they may go much farther. Athenæus remarks this circumstance, and says that the incurvated lobsters will spring with the activity of dolphins. Their eyes are raised upon moveable bases, which enables them to see readily every way. When frightened, they will spring from a considerable distance to their hold in the rocks; and, what is not less surprising than true, will throw themselves into their hold in that manner through an entrance barely sufficient for their body to pass, as is frequently seen by the people who endeavour to take them at Filey Bridge. In frosty weather, if any happen to be found near the shore, they are quite torpid and benumbed."

The lobster was known to the ancients and is probably the *οσταкος* of the Greeks.

The River crayfish (Astacus fluviatilis) is a native of the rivers and streams of our island and the adjacent continent, especially where the bed is rocky and stony.

Passing from the lobsters we may next turn to those crustaceans known as shrimps and prawns. And here we may remark that under the term shrimp are sold at Billingsgate and other markets two very distinct species, belonging indeed to different genera; one the common shrimp (Crangon vulgaris), the other allied to the prawn, and often termed the white or Medway shrimp (Palemon squilla). We shall first notice the Crangonians, or true shrimps, in which the anterior limbs are subcheliform, terminating in a hooked moveable claw, to which is opposed a fixed spine on the penultimate joint. In Crangon the carapace is depressed, and presents only the rudiment of a rostrum; the eyes are short, large, and free: the antennæ are inserted nearly on the same transversal line. The locomotive limbs are slender and long; the two last the longest and shortest. The details of Crangon are given at Fig. 3210, in which the forms of the antennæ and limbs are well delineated: *a*, the mandible.

It has been proposed to separate from Crangon a genus under the name of Egeon (Risso), but on slight grounds, deemed insufficient by Desmarest: the second pair of limbs are very short and didactylous, and the last visible joint of the outer jaw-feet enlarged. To this genus, or rather subgenus, belong the Egeon loricatus (Cancer loricatus) of the European seas. It is represented at Fig. 3211.

Fig. 3212 represents the common shrimp (Crangon vulgaris): *a*, one of the claws.

This species, the Crevette or Chrevette and Cardon of the French, is too well known to need a description. It is taken on the flat sandy shores of our island, and of the adjacent continent, often by boys and women, who wade up to their knees or higher, pushing a sort of dredge net at the end of a long pole before them; a more wholesale way of collecting them is by means of sweep nets, dragged over the fishing-ground by men in boats. The degree of success is variable, but sometimes immense numbers are taken. Paley in his 'Natural Theology' relates a circumstance which will give some idea of the shoals of these animals which wander through the sea. "Walking," he says, "by the sea side, in a calm evening, upon a sandy shore and with an ebbing tide, I have frequently remarked the appearance of a dark cloud, or rather very thick mist, hanging over the edge of the water, to the height perhaps of half a yard, stretching along the coast as far as the eye could reach, and always retiring with the water. When this cloud came to be examined, it proved to be nothing else than so much space filled with young shrimps in the act of bounding into the air from the shallow margin of the water or the wet sand." Any attempt to calculate the numbers composing an extensive cloud of shrimps must be overwhelming.

By way of pictorial illustration we give at Fig. 3213 the spirited figure of a young shrimp-catcher examining his net, the scion of a bold race, that "weel the boatie row, to win the bairn's bread."

Another tribe of shrimps, of stouter form than the preceding, are termed Alpheans; the genus Alpheus being the type.

To this tribe belongs a singular species, the only known example of the genus Atya, in which the two anterior limbs are equal, with the penultimate joint short, the last joint divided.

The Atya scabra, Leach, Fig. 3214, is a native of the seas of North America.

The Palemonians, Les Salicoques of the French, constitute the next tribe of shrimps. The carapace is armed with a great sabre-like rostrum, nearly always serrated above. All the limbs are slender; the two first pairs are generally didactylous, the three last never so. The genus Palemon, of which the prawn and the white shrimp are examples, has the lamellar palp which covers the base of the antennæ, large, oval, and rounded, ciliated at the end, and armed with a spine at its external border. The internal antennæ send off one short and two long multiartilate filaments; the external antennæ one long filament. The abdomen is large, with ample oar-like false feet. The seas of India produce species of this genus of extraordinary size, as do also those of the Antilles. Those found in our seas are moderate or small. They swim well, and the shoal on the appearance of an enemy scatters rapidly in all directions.

The Prawn, Palemon serratus, Fig. 3215, is celebrated as a great delicacy: its colour is greyish, freckled with red and brown; when boiled it becomes of a clear flesh red. The white shrimp, Palemon squilla, is an allied species of much smaller size, and there is a third species on our coasts, Palemon varians, which is still more diminutive.

The prawn is much infested by a minute parasitic crustacean (Bopyrus Crangorum), which inserts itself into the branchial chambers and adheres to the branchiæ.

Another tribe comprehends several genera, as Penæus, Stenopus, Euphemia, &c., in which the abdomen is extremely elongated; and the limbs often carry a palpiform appendage at their base more or less developed; and vary much in their conformation. But we must pass from them to a remarkable tribe of crustaceans, called Scyllarians, to be distinguished at once by the singular conformation of the antennæ.

The carapace is very wide, and presents anteriorly a horizontal prolongation advancing between the base of the external antennæ, and covering the insertion of the first pair. The eyes are placed in well formed orbits, and are remote from each other. The first pair of antennæ present nothing very remarkable; they are rather short, and bifid at their apex. The external antennæ are like wide foliaceous expansions. The abdomen is wide, and terminates in a great fan-shaped fin. The jaw-feet are moderate.

In the first genus, Scyllarus, the carapace is longer than wide, the lateral borders are parallel, the orbits lateral; the abdomen stout. Fig. 3216 represents one of the jaw-feet.

Fig. 3217 is the Scyllarus æquinoctialis, a large species, measuring a foot in length, found in the

seas of the Antilles. It is of a yellowish colour mingled with red.

From the genus Scyllarus is separated a form termed Thenus, distinguished by the depression of the body, which is narrowed from before backwards. The ocular peduncles are long, and the eyes appear at each outer anterior angle of the carapace.

We select as an example the Thenus orientalis (Fig. 3218), a native of the Indian Seas: it is about eight inches in length.

More singular still is the genus Ibacus, in which the carapace is extremely wide, with a lamellar expansion on each side covering the greater portion of the feet, as in Calappa, among the crabs. These expansions advance forwards, and are divided on each side by a deep fissure, into two unequal portions; the orbits are closer together than in Scyllarus or Thenus. The external lamelliform antennæ are of great expanse. Fig. 3219 represents in outline the carapace of Ibacus seen from above. The Ibacus Peronii (Fig. 3220) is a native of the Australasian Seas. It measures five inches in length.

In these three genera the first four pairs of limbs terminate in a simple point, and in the males the fifth pair end similarly, but in the female terminate in an incomplete pincer. There are four pairs of false or abdominal feet; in the female they are well developed. We now advance to a tribe of Macrura, represented by the genus Palinurus, and termed Langoustians by M. Milne Edwards, and characterized by the absence of claw-pincers.

The Palinuri or Langoustes have, says Cuvier, the lateral antennæ large, setaceous, and covered with spines. "Among these Crustacea, called by the Greeks καράβος, and the Latins Locusta, respecting which Aristotle has given many important observations, there are some which with age acquire the length almost of two yards (deux mètres), taking the antennæ into the admeasurement. The species found in our latitudes resort during the winter to the depths of the sea, and approach the shore only on the return of spring. They give preference to rocks or rocky situations. The females breed at this season, and the eggs, which are small and very abundant, are of a beautiful red colour, whence the term coral, which from this cause has been applied to them. More males than females are captured, although the latter are the most after the breeding season. According to M. Risso, the females breed a second time in August. These Langoustes are spread in all the seas of all the temperate and intertropical zones, but especially in the latter. The carapace is rough, bristling with spines, and presents anteriorly large spikes, directed forwards and more or less numerous. The general colours present an agreeable mixture of red, green, and yellow; and the tail is often marked with transverse bands or spots, sometimes in the form of eyes disposed in rows. The flesh, especially that of the females before and during the laying season, is much esteemed." The genus Palinurus presents the following characters:—the carapace is nearly straight, armed at its anterior border with two stout horns, which advance above the eyes and base of the antennæ, and on each side below the eyes there is a horn more or less developed. The carapace is covered with spines; the eyes are large; the internal antennæ are long, and end in a bifid joint. The external antennæ are stout, and of great length, often far exceeding that of the body; the jaw-feet are small. All the limbs end in simple joints. The abdomen is large, and has four pairs of false feet. The caudal fin, formed by the seventh abdominal ring and the appendages of the preceding ring, is very large, and to a great extent of a flexible consistence.

Fig. 3221 represents the under surface of the Sea crayfish, or Langouste (Palinurus vulgaris). Fig. 3222 is the Palinurus vulgaris, the Sea crayfish, or crawfish, so abundant in the London markets. It is in very general use as an article of diet, and certainly is excellent, but in flavour and tenderness of fibre is far inferior to the lobster. It occasionally weighs from ten to fifteen pounds. In the female there is a sort of spur or tooth at the extremity of the last joint but one of the posterior limbs; it does not exist in the male.

A beautiful species of the present genus, Palinurus guttatus, Fig. 3223, is found in the seas of the Antilles. The colour is green with many circular yellowish spots; the penultimate joint of the limbs is striated longitudinally with green and yellow.

M. Milne Edwards informs us that there is in the Paris Museum a limb, apparently the third, of extraordinary proportions, belonging to a species of Palinurus; it is more than two feet in length (French measure), and proves the existence of a gigantic crustacean of this genus, as yet unknown to naturalists. The specimen in question came from the Isle of France.

A very interesting group or family of Macrura are termed Thalassinians by M. Milne Edwards, from the typical genus Thalassina. They appear to be burrowing in their habits, and are all of small size, living on sandy shores. M. Milne Edwards arranges them between the Scyllarians and Astacians, but some of the genera, in which there are accessory branchial appendages affixed to the false feet, seem to approximate towards the Stomapods.

They are all remarkable for the length and slenderness of the abdomen; the anterior pair of limbs are furnished with chelæ, and sometimes the second pair are terminated by pincers. The carapace is small and compressed laterally, generally advancing in front in the form of a small rostrum, but sometimes this is wanting. The eyes are minute. The internal antennæ are terminated by two multiarticulate filaments; the external antennæ by a single filament. As we have said, the respiratory apparatus varies. Sometimes, besides the thoracic branchiæ, there are additional branchiæ suspended under the narrow slender abdomen, and attached to the false feet. Upon this difference M. Milne Edwards divides the Thalassinians into two sections, viz., Cryptobranchids and Gastrobranchids. In the Cryptobranchids there are no accessory abdominal branchiæ, and the true branchiæ in the thoracic cavities are united in the manner of a brush. All the species of which the habits are known burrow to a considerable depth in the sandy bed of the sea.

To this section belong the genera Axia, Gebia, Thalassina, and Callianassa.

In the genus Axia the carapace is much compressed, and terminated anteriorly by a small triangular rostrum. The ocular peduncles are small and cylindrical. The anterior limbs are compressed and terminate in a well-formed claw: the next pair of limbs have small pincers; the rest are simple. There are five pairs of false abdominal feet.

Of this genus only one species appears to be known, namely, the Axia Stirhynchus, Fig. 3224. It is about three inches in length, and inhabits the coasts of France and England: *a*, one of the internal antennæ; *b*, one of the external antennæ.

In the genus Gebia the anterior rostrum of the carapace is triangular, and sufficiently large to cover the eyes almost entirely. The internal antennæ are short; the external antennæ slender. The anterior limbs are narrow, and terminate in a subcheliform manner. The other limbs have simple terminations. The abdomen is long, narrower at its base than towards its middle, depressed and terminated by a large fin; the four lateral blades are foliaceous and very wide. The first abdominal ring has two pairs of small filiform false feet; the four next segments give origin to three pairs of false natatory feet, composed of a short and stout peduncle, and two oval blades with ciliated edges.

The Gebia stellata, Fig. 3225, is an example; it is about an inch and a half in length, and is a native of the coasts of England: *a*, one of the internal antennæ; *b*, the base of one of the external antennæ.

In the genus Thalassina the carapace is short, narrow, and elevated, and furnished in front with a triangular rostrum. The peduncles of the eyes are small and cylindrical. The internal antennæ have two short slender filaments; the external antennæ are small and slender. The first pair of limbs are rather robust and subcheliform; the moveable claw antagonizing with a toothlike process of more or less strength on the penultimate joint. An approximation to this form is displayed by the second pair of limbs, the penultimate joint being large and ciliated. The abdomen is long and narrow: slender false feet are attached to the four middle rings. The terminal fin is small; the two lateral blades furnished by the preceding or sixth ring are small and nearly linear.

Our example is the Thalassina scorpionoïdes, Fig. 3226, from the coasts of Chile. It is of a brownish colour, and measures about six inches in length. Its abdominal segments remind us of the segments of a Scolopendra, or centipede.

In the genus Callianassa the general characters approximate to those of Thalassina, but the two anterior limbs, which have both true chelæ, differ from each other very greatly in size, as we have already seen in the Hermit-crabs (Pagurus). The lateral caudal plates are large.

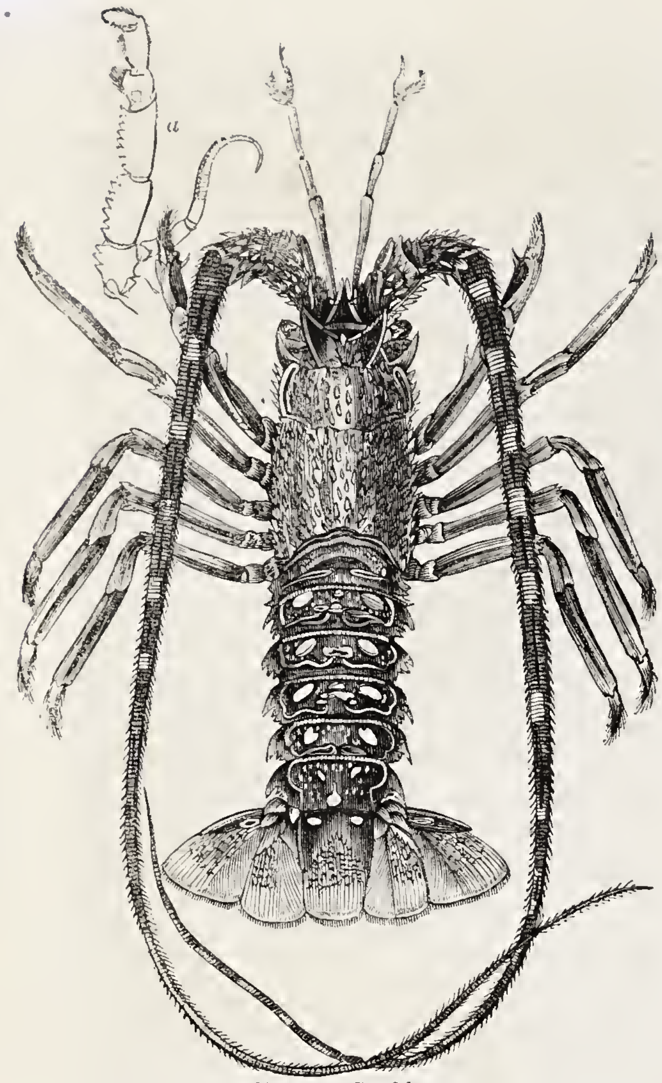
One species, Callianassa subterranea, Fig. 3227, is found on the sands of the sea-shore, washed up by the tides, on the French and English coasts: *a*, one of the internal antennæ; *b*, the base of one of the external antennæ; *c*, the right or large chela. M. Milne Edwards records another species, Callianassa uncinata, and observes that the C. major of Say appears to differ from both.

We now turn to the Gastrobranchid section, which, besides thoracic branchiæ, have respiratory appendages fixed to their abdominal false feet, a point in which they exhibit an analogy with the crustaceans of the order Stomapoda. The type of this section, according to Milne Edwards, is a small crustacean, to which he gives the generic name of Callianidea, and which he characterizes as follows:—Body very delicate, slender, and elongated; carapace hardly a third of the length of the abdomen, and not covering the last thoracic ring, compressed and rather elevated, its lower border applied exactly against the base of the four first pairs of feet. No rostrum; and the anterior border of the carapace notched on each side of the median line for the reception of the base of the eyes, whose peduncles are very short, and formed as in the Callianassæ. Four antennæ, slender and inserted nearly on the same transversal line; the first pair terminated by two filaments nearly equal in length, one of which however is the largest, and slightly convex towards the end. Appendages of the mouth very small, occupying but little space; mandibles hardly differing from those of Callianassa; valvular appendage of the second pair of jaws very small; external jaw-feet slender and pediform, their second joint furnished internally with a row of dentiform tubercles covered with hairs, and with their three last joints very much elongated. Sternum linear throughout its extent. First pair of feet long, and one of them very stout, with the terminating hand very large, and nearly of the same form as in Callianassa, except that the carpus is smaller. The two succeeding pairs of feet are small and flattened; the fourth pair nearly cylindrical, and their basilary joint very much enlarged. Fifth pair nearly as large as the fourth, and terminating in an imperfect rudimentary claw. Abdomen composed as ordinarily of seven segments, nearly of the same size throughout, and carrying beneath five pairs of false feet; of these the first are reduced to a simple narrow blade slightly ciliated at the end, but the four succeeding pairs have a very remarkable conformation. A peduncle is to be distinguished, and three terminal laminæ, two of which are very large, and one very small, on the edge of the preceding ones; all round the border of the great laminæ a kind of tufted fringe is found, composed of a row of cylinders, each of which gives origin to two smaller filaments, which again in their turn are bifurcated nearly in the same manner as the branchial filaments of the Squillæ are divided. The five blades of which the caudal fin is composed are wide and rounded. The thoracic branchiæ are enclosed as ordinarily in the carapace, and are each composed of cylinders ranged in parallel order on a stem, nearly as in the lobsters, only these organs and filaments are less numerous, and the branchiæ themselves very small. There are only ten on each side of the body. (M. E.)

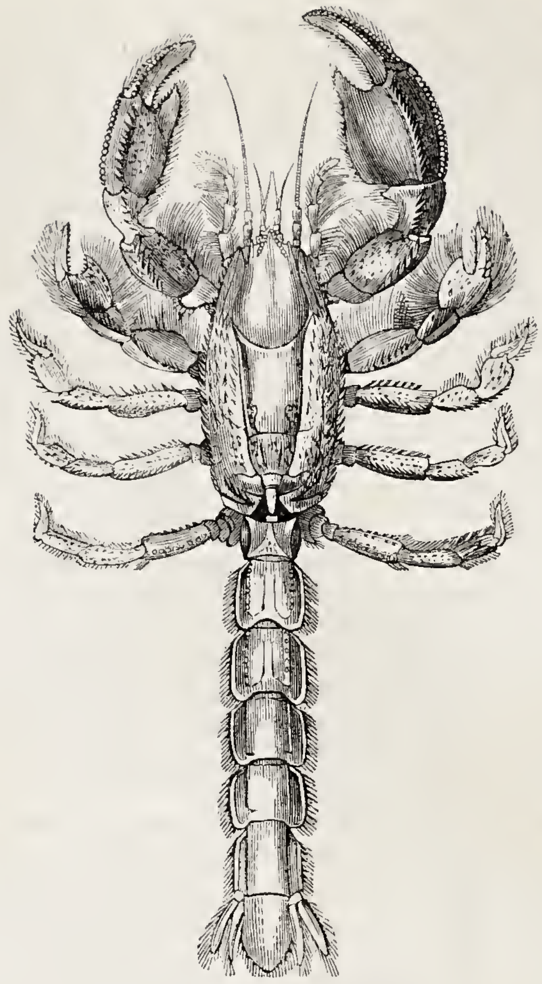
Fig. 3228 represents the Callianidea typa greatly magnified. Its length is about ten lines; it was found by MM. Quoy and Gaimard on the coasts of New Ireland: *a*, one of the internal antennæ, bifid and plumose; *b*, one of the external jaw-feet; *c*, extremity of one of the posterior feet; *d*, one of the first pair of the abdominal false feet; *e*, a false foot of one of the succeeding pairs; *f*, the marginal fringe of the latter feet. These figures are all magnified.

We may here allude to an anomalous form of the Macrurous Decapods, found only in a fossil state, and which, as Desmarest observes, appears to constitute a section by itself. The generic title proposed by this zoologist is Eryon, with the following characters:—External antennæ short (one-eighth of the total length of the body including the tail), setaceous, provided at their base with a rather large scale, which is ovöid and strongly notched on the internal side; intermediate antennæ setaceous, bifid, much shorter than the external ones, and having their filaments equal. Feet of the first pair nearly as long as the body, slender, linear, not spinous, terminated by very long and narrow chelæ, with fingers little bent, but slightly inflected inwards; carpus short; feet of the other pairs also slender, and those of the second and third pairs terminated with pincers, like the feet of the crawfishes (écrevisses). Carapace very much depressed, wide, nearly square, but little advanced anteriorly, profoundly notched on its latero-anterior borders. Abdomen rather short, formed of six articulations, of which the four intermediate ones have their lateral borders prolonged in angles, well detached, as in the crawfishes. Caudal fin formed of five pieces, of which the two lateral are entire, rather large, a little rounded on the internal side, and the three middle ones triangular and elongated, especially the intermediate one.

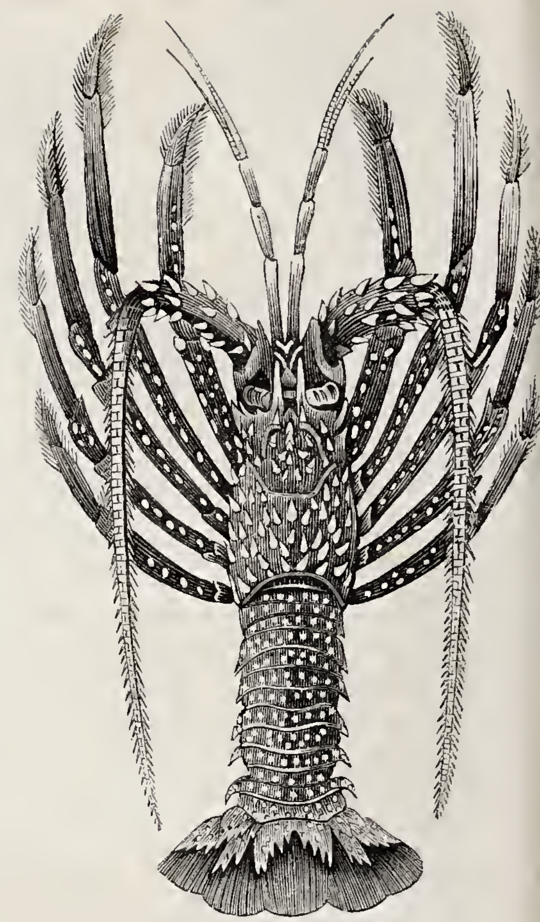
According to M. Desmarest, it is to the Callianassæ, the Thalassinæ, the Gebiæ, and the Axiæ, that Eryon bears relation. Nevertheless it has not, he observes, the habit of any of them. Its short depressed carapace, and its little elongated abdomen, approximate it to Scyllarus, but its internal antennæ with short peduncles, its external setaceous antennæ, and its great anterior didactylous feet, widely separate it from that genus. It cannot be confounded with Palinurus, which has the external



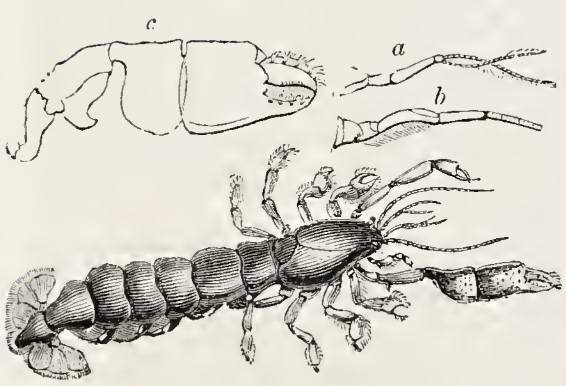
3222.—Sea Crayfish.



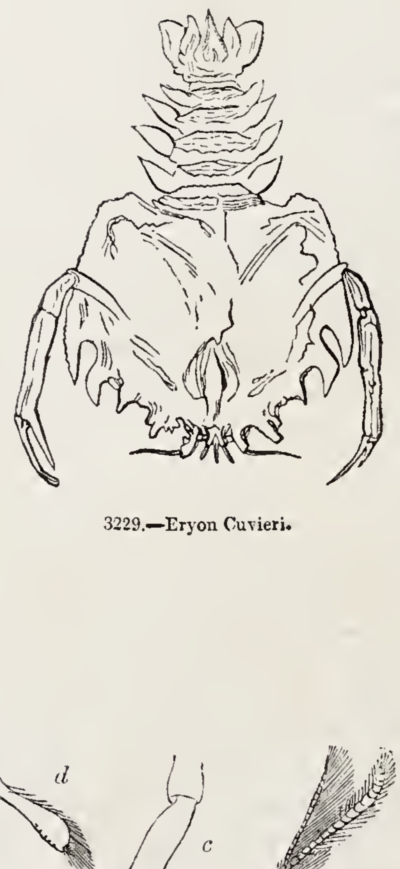
3226.—Thalassina scorpionoides.



3223.—Crayfish of the Antilles.



3227.—Callianassa subterranea.

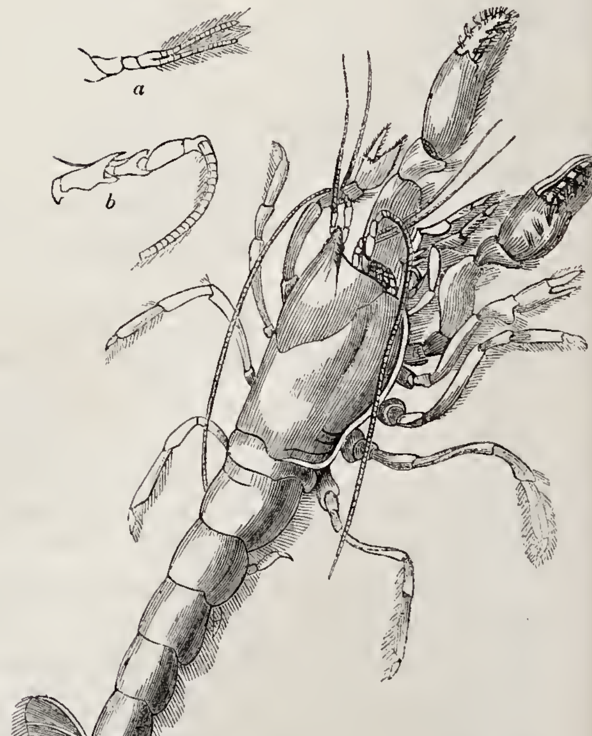


3229.—Eryon Cuvieri.

3225.—Gebia stellata.

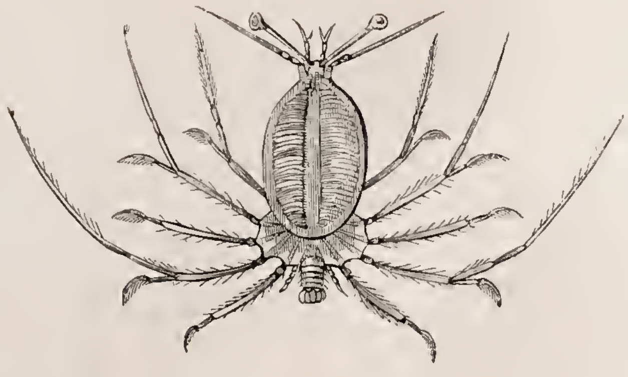
3221.—Sea Crayfish: Under Surface.

3228.—Callianidea typa.

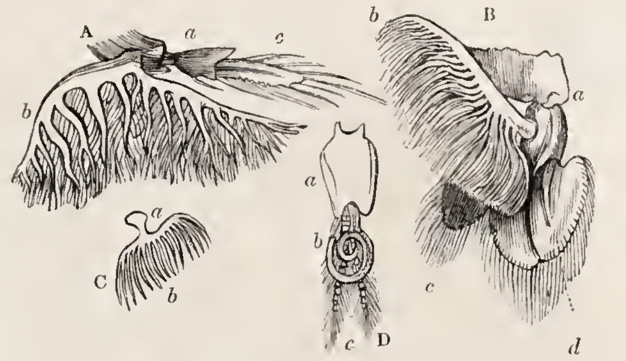


3224.—Axia stirhynchus.

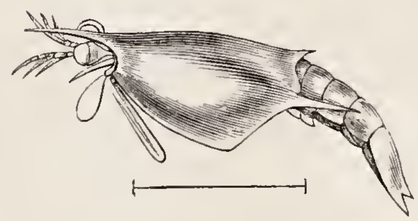
3233.—Lucifer typus.



3234.—Phyllosoma commune.

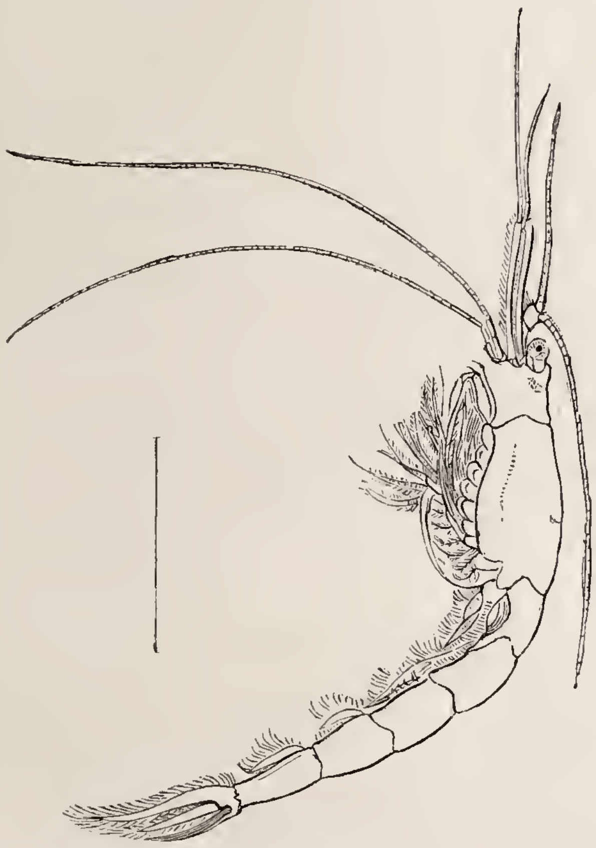


3230.—Branchiæ of Stomapods.

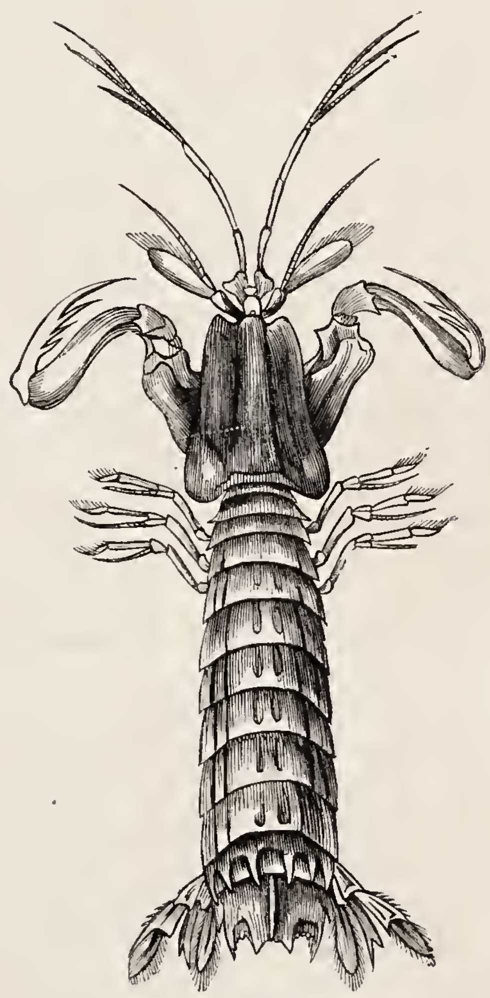


3237.—Erichthus vitreus.

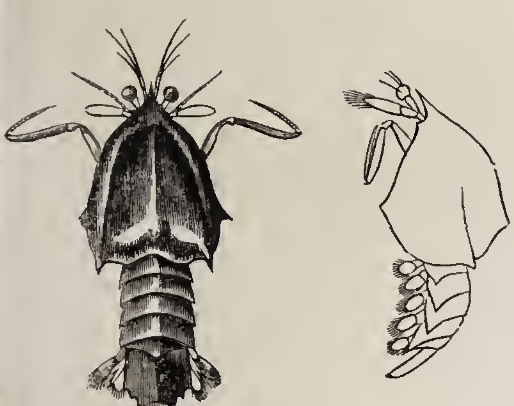
3236.—Eyes and Antennæ of Phyllosoma and P. brevicorne.



3232.—Mysis vulgaris.

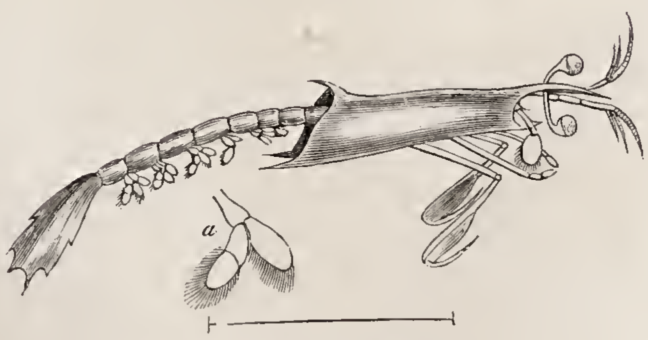


3240 — Squilla Mantis.

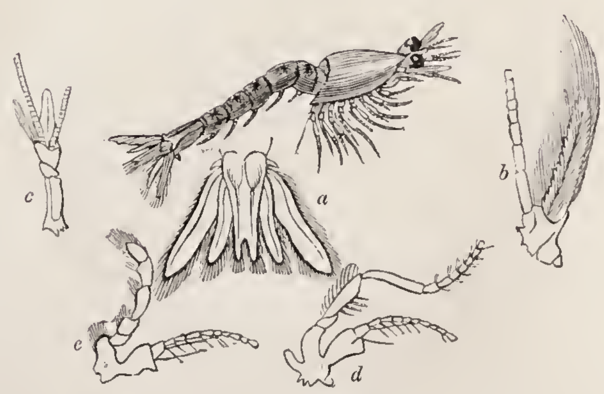


3238.—Erichthus Duvancellii

3235.—Phyllosoma clavicorne.



3239.—Alima hyalina.



3231.—Mysis Fabricii.

antennæ and the peduncles of the internal ones so long, and whose feet are all monodactylous; and, finally, it cannot be referred to the crawfishes or lobsters (Astacus), whose shell is differently formed, and which have the external natatory blades of the tail composed of two pieces; but Desmarest thinks that it is to the last-named genus that Eryon most approximates, taking into consideration its general character. He regrets that he has not been able to satisfy himself whether the four antennæ are inserted on the same horizontal line or not, a fact which would have assisted him in his comparison with other genera.

Fig. 3229 represents the Eryon Cuvieri. It is from the lithographic limestone of Pappenheim and Aichstedt in the Margraviat of Anspach. The carapace is finely granulated above, marked by two deep and narrow notches along the two latero-anterior borders, and finely crenulated on the posterior part of the lateral borders. It measures about five inches in length.

The fossil forms of Decapod crustaceans, it may be remarked, are very numerous, and have been found in an extensive series of fossiliferous beds, below and in the chalk, up to strata of comparatively recent formation. Their remains are often in a singularly perfect state of preservation, even to the eyes, antennæ, and branchiæ.

We here close our sketch of the Decapod crustaceans, and advance to the next order, which we shall find to contain some curious and grotesque forms, differing in many structural points of great consequence from any of the Decapods, and more particularly in the arrangement of the branchial or respiratory apparatus, which is in the form of plumose appendages to the limbs.

ORDER STOMAPODA.

In this order of crustaceans the general form is elongated, and well adapted for aquatic provision. They have always a thoracic section, but in most the ophthalmic and antennular rings are not confounded with the rest of the head; and the carapace itself exhibits many variations of structure, and is generally composed of segments moveable on each other. Sometimes, however, all the rings are consolidated into a single piece. The conformation of the abdomen is even more variable still; but in general consists of segments, and terminates in a caudal fin, composed of the seventh segment and appendages of the sixth. The eyes are carried on a pair of moveable peduncles, often of great length. The internal antennæ are rather long, and terminate in two or three multiarticulate filaments; the external antennæ are very variable, and the basal joint of their peduncle mostly carries a large ciliated blade. The mouth is far more simple than in the Decapods; it is composed of an upper lip, a pair of mandibles, a lower lip, two pair of jaws, and a single pair of jaw-feet; the latter indeed are sometimes wanting, but where present are transformed into swimming feet; and the seven following pairs of limbs are so constructed as to form either swimming or prehensile organs.

With respect to the limbs, indeed, of the Stomapods, they usually amount to the number of seven or eight pairs, often presenting the same details of conformation. They are mostly provided with an appendage or palp, and some have at the base a vesicular appendage, which is often flat and rounded; the three last pairs, and sometimes more, are always natatory, and the first pair, and often the four first pairs prehensile, but never terminate in a true pincer, being only subcheliform, a moveable claw falling on the preceding joint. The greater part of these limbs are approximated to the mouth, or even closely applied to it, and it is to this circumstance that the appellation stomapods refers (στομα, a mouth, πους ποδος, a foot).

The abdominal or false feet are generally found to amount to six pairs; and it is to these that the branchiæ, in the form of tufts or plumes, are attached, at least where such organs can be detected, for in some no tufts, fringes, or other special organs of respiration can be detected, the necessary purification of the blood being effected, as is supposed, over the general surface of the body. These branchial fringes, though ordinarily attached to the base of the false or abdominal feet, are nevertheless in some instances affixed to the base of the thoracic feet, and consequently suspended under the thorax; but this plan is not according to the general rule. Fig. 3230 will serve to convey a clear idea of the appearance of the branchial tufts or fringes in the present group. A, one of the branchiæ of Thysanopoda; *a*, base of the posterior limb; *c*, the palp; *b*, branchial fringe: B, one of the branchiæ of Squilla; *a*, base of the false foot; *b*, branchial fringe; *c* and *d*, the two terminal branches of the false foot: C, one of the portions of which the branchial fringe of the preceding is composed; *a*, the base; *b*, the filaments into which it ramifies: D, one of the abdominal false feet of Cynthia; *a*, the basal joint; *b*, the branchial apparatus; *c*, lamellar appendages.

With a modification of the branchial organs, we shall not be surprised to find a modification also of the apparatus of circulation. The heart, instead of being situated in the centre of the thorax, extends through the abdomen, in the form of a long cylindrical tube, giving off arteries, and receiving blood from abdominal venous reservoirs. The stomach is unarmed with teeth. M. Milne Edwards divides the Stomapods into three tribes; viz., the Caridoïds, the Bicuirassed, and the Unicuirassed.

The Caridoïd stomapods bear in their general form a close proximity to the shrimps; the body is thick and slightly compressed at the sides; the head is confounded with the thorax, and all the rings of the latter, with the exception sometimes of the last one or two, are united together. The abdomen is considerably developed, and consists ordinarily of seven rings, the first five of which carry false natatory feet; the terminal fin consists of five fan-shaped blades. Sometimes no branchiæ are present, sometimes vestiges of them are found attached to the abdominal feet; and sometimes, on the contrary, they are greatly developed and suspended under the thorax. The carapace is very ample, and descends low on each side; it presents only a rudimentary rostrum in front.

To this group or tribe belongs the genus Mysis, containing the opossum shrimps, so called from having a pouch for the reception of the eggs and young, analogous to that of the Marsupial quadrupeds. This pouch is formed by a flabelliform appendage or scale, of considerable size in the females, and attached to the base of the two last pairs of thoracic feet; these appendages are bent under the sternum, and, overlapping each other, constitute a receptacle for the eggs, and also of the young during the early part of their life. According to Mr. Thompson, the eggs, enveloped in a gelatinous fluid, when received into the pouch are considerably more advanced than those of shrimps, crabs, &c., but by no means so numerous, "a circumstance more than compensated by the rapidity with which one brood succeeds another during the whole of the spring and summer months. The number of broods produced by one individual, as well as the time occupied in their evolution, have not been determined; but the changes which the embryo undergoes in configuration are sufficiently obvious. In the present instance these cannot be considered as metamorphoses, but simply a gradual development of parts. The first change perceptible in the eggs after their reception into the pouch is a slight elongation at one end, and the appearance of two short members on each side; this elongation, which proves to be the tail, increasing in length, shortly after becomes forked at the end, accompanied by a proportional growth of the four lateral members, and which are the rudiments of two pairs of antennæ in the perfect animal. The embryo going on thus with a progressional development from day to day, begins to assume a more complete form, and an approximation to that of the parent, in which stages the divisions of the abdomen, the tail, the pedunculate eyes, and the various members are sufficiently distinct. A still more close resemblance to the perfect animal is attained before the young are finally excluded, which is effected by the parent spreading open the valves of its pouch, when the whole brood emerge at once into the ambient element, and in most of the species continue associated with the community from which they sprang."

The opossum shrimps abound in the northern seas; the Arctic ocean teems with myriads forming, not troops, but vast clouds, spreading over leagues of water, and affording sufficient and most nutritive food to the whale, and to the prodigious shoals of salmon which visit the shores of Boothia and the mouths of rivers, in July and August, and upon which the inhabitants of that dreary region depend in a great measure for their store of winter provisions. During summer the opossum shrimps absolutely crowd the mouths of the rivers, and there their destroyers revel in a perpetual feast.

Fig. 3231 represents the Mysis Fabricii, Leach, magnified; *a*, the last ring of the body or terminal fin; *b*, the base of one of the lateral antennæ; *c*, the base of one of the inner antennæ; *d*, one of the second pair of jaw-feet; *e*, one of the first pair of jaw-feet.

Another example of the genus is the Mysis vulgaris, Fig. 3232, magnified.

This species is common on the Irish coast, where in some parts it is very abundant, associated myriads forming a wide belt along the margin of the water. Like the shrimp these crustaceans swim in a horizontal manner, and when pursued by fish, often spring out to a considerable height above the surface.

To the caridoïd section may be referred that singular genus termed Lucifer—remarkable for the excessive length of the anterior portion of the head; the extreme brevity of the thoracic section, where the mouth is sealed; and the great length of the abdomen and of its several segments. The eyes are carried at the end of long and somewhat club-shaped peduncles. There are no thoracic, or abdominal branchiæ.

Fig. 3233 represents the Lucifer typus, magnified and of the natural size. It swarms in the tropical latitudes of the Atlantic, and is luminous, contributing, with other minute phosphorescent creatures, to the nocturnal effulgence of the ocean. A distinct species, Lucifer Reynaudii, exists in the Indian seas.

The Bicuirassed Stomapods present us with forms of strange aspect, remarkable for their rounded shape and the transparency of their integuments. The carapace forms a lamellar leaf-like shield above, covering the dorsal aspect of the thorax, and the thorax is equally flat and resembles a thin plate placed horizontally, and it is to these two bucklers that the term Bicuirassed or double-cuirassed refers. The abdomen is small, sometimes rudimentary; the false feet are but little developed. The true limbs are from seven to eight pairs, of which the first pair are very short, and sometimes also the last, whilst the others are long and slender, and formed for spreading out over the surface of the water, on which they can rest. The external antennæ are long and stout; the eyes are at the end of long peduncles. There are no organs which can be considered as branchiæ. To this section belongs the genus Phyllosoma, of which one species, the P. Mediterranea, is found in the warmer seas of Europe, and another, P. Sarniense, Lukis, has been taken at Guernsey; the seas of Africa, India, and New Holland furnish the rest.

So transparent are these crustaceans, that as they float on the clear surface of the water, they would escape observation were it not for the beautiful blue colour of their eyes, by which their presence is betrayed.

Fig. 3234 is the Phyllosoma commune, a native of the seas of Africa and India; and Fig. 3235, the Phyllosoma clavicorne, found also in the same localities. Fig. 3236 represents the eyes and antennæ of two short-tailed species: *a*, those of Ph. laticorne, from the Indian seas; *b*, of Ph. brevicorne, from the seas of Africa and Asia.

The Unicuirassed Stomapods have the thoracic integument in the form of a single buckler, elongated and quadrilateral, generally enlarged and free behind, and covering the head with the exception of the eyes and antennæ, which are based upon a distinct anterior segment. All the jaw-feet, of which the second are very large, and the four anterior true limbs are close to the mouth, on two converging lines. The first pair of thoracic limbs are largely developed, and constitute great raptorial organs; the last joint bends back like a long claw along the internal border of the preceding joint, so as to form a sort of pincer by which the animal seizes its prey. The three succeeding pairs of feet are much smaller, and terminate in an oval hand armed with a moveable claw, disposed so as to bend back and constitute an organ of prehension. At the base of the limbs externally is a small flattened vesicular appendage, supposed by some to be a respiratory organ, but distinct plumose branchiæ, in most, are affixed to the base of the false abdominal feet. The abdomen is well developed, and consists of seven segments, of which the last is modified into a broad caudal blade. As examples of this group, we select the genera Erichthus, Alima, and Squilla.

In the genus Erichthus the carapace is very large and convex, armed anteriorly with a spiny rostrum, and posteriorly with strong spines; the abdomen is broad, and the caudal plate large. The eyes are well developed and pear-shaped. The internal antennæ have three filaments. The limbs are small, and even the raptorial claws are but moderate.

The Erichthus vitreus, Fig. 3237, will serve to convey a clear idea of the general form and characters of the genus: it is a native of the South Atlantic Ocean. Fig. 3238 represents another species, Erichthus Duvancellii, from the Gulf of Bengal.

The genus Alima differs from Erichthus in the length and narrowness of the carapace, and the slenderness of the abdomen, which terminates in a large leaf-like paddle. The eyes are carried on slender peduncles directed outwards. The posterior border of the carapace is generally notched, so as to leave exposed the two last thoracic segments. The thoracic feet are formed as in Erichthus; the abdominal false feet are large, but are in general destitute of branchiæ, though sometimes rudimentary branchiæ exist on the first pair. Some species have the claw of the raptorial feet armed with spines, in others it is unarmed. Among the latter is the Alima hyalina, a native of the seas of New Guinea, represented at Fig. 3239. The Erichthians, it may here be observed, have as yet been observed only in tropical latitudes, and generally at a distance from shore, out in the

open sea; none are of large size; their habits are unknown. Of another group, called Squillians, the genus Squilla may be taken as the type.

The crustaceans of this genus, as at present restricted, have the raptorial claw of a falcular shape, and armed on its inner edge with sharp teeth, which are received when it is shut down, or folded into a corresponding groove of the preceding joint, which is equally compressed, and generally armed with spines on its prehensile border. The carapace is small, and the three last pairs of thoracic limbs carry a slender elongated stylet, which represents the palp.

Fig. 3240 represents the Squilla Mantis, which is common in the Mediterranean, and is occasionally seen in the British Channel. It is about seven inches in length, and of a pale yellowish grey; its falcular claws are armed with three teeth; the abdominal segments, the last excepted, have six longitudinal ridges. The last has a strong medial ridge, and terminates in four strong teeth, and a double series of fine serrations.

The squillæ are active predatory animals, well furnished with instruments of rapine, and are amongst the most carnivorous of their race. They generally keep at a distance from shore, swimming with extreme swiftness, striking the water with their caudal paddle, while their abdominal feet are incessantly in motion. These crustaceans are most abundant in the warmer parts of the ocean, and inhabit considerable depths. To the genus Squilla, the genera Gonodactylus and Coronis are closely related.

ORDER AMPHIPODA.

In this order the eyes are sessile and immoveable; the mandibles, as in the preceding order, are furnished with a palp, the abdominal appendages are always apparent and elongated, and in their joints, bifurcations, &c., resemble false feet, or pieds-nageoires; they are ciliated, the ciliæ appearing to fulfil the office of branchiæ. Many have vesicular pouches placed either between the limbs or at their external base. In the Stomapods and Læmodipods this structure is also to be found. The first pair of limbs, corresponding to the second jaw-feet, are always annexed to their own segment, viz., the first after the head. The antennæ, ordinarily four in number, are composed of a peduncle and slender filament, sometimes accompanied by a little lateral branch. The body is mostly compressed and bent. The appendages of the tail generally resemble little jointed stylets. The crustaceans of this order are all minute, and swim and leap with great facility, but always on one side. Some are found in streams and rivulets, but most in salt water; their colour is of a uniform pale red or greenish. Latreille divides these crustaceans into such as have fourteen feet, all terminated by a hook or simple point; secondly, such as have more than fourteen feet, but of which the four first at least are not pointed and natatory; thirdly, such as have only ten apparent feet.

Among our pictorial specimens of the Amphipoda, we may first turn to that well-known little species the Freshwater shrimp, or Crevette des Ruisseaux, common in all our rivulets and shallow water-courses. It belongs to the genus Gammarus, in which the four anterior pairs of feet are terminated in hooks, the four next in simple points. The body is divided into thirteen segments, exclusive of the head, and from the seven first a lateral horny plate is continued, which hides the base of the limbs.

Fig. 3241 represents this species, the Gammarus Pulex of Latreille: it is magnified at *a*; and at *b*, the head and antennæ are seen still more magnified. This active little creature swims with great rapidity, performing its movements by a series of jerks, and generally at the bottom of the water, on its side, over the soft muddy bed, into which it plunges for safety. It is carnivorous, feeding on dead fishes and other aquatic animals. The male exceeds the female in size. The latter keeps her eggs until they are hatched under the shelter of the lateral plates of the abdomen, and the young are retained there for some time after exclusion.

Closely related to Gammarus is the genus Atylus, of which a little marine species, Atylus carinatus, is an example, Fig. 3242. The body, including the head, is composed of twelve joints.

Another allied genus is that termed Melita, in which the second pair of limbs in the male are terminated by a large compressed plate, on the inner surface of which the claw is folded. We give as an example the Melita palmata, Fig. 3243, a small crustacean found under stones on the sea-shore.

Among the Amphipods most commonly to be seen on our shores is the Sand-Hopper, Talitrus Locusta, found under stones, or under the mass of exuviæ thrown up by the tide on sandy shores, in troops of thousands, all active and leaping when disturbed in their retreats, and so prompt in gaining a fresh hiding-place or in burying themselves, that it requires some address to catch them.

We now turn to a singular genus, viz., Cerapus, in which the antennæ are very large, the peduncle of the upper consisting of three, that of the lower antennæ of four joints. The anterior pair of limbs are small, the next pair large, terminating in a dilated triangular joint, dentilated and armed with a sharp moveable two-jointed hook.

The Cerapus tubularis, Fig. 3244, is found in abundance in the sea near Egg-Harbour, in the United States. It lives in a small cylindrical tube, supposed to be that of a Tubularia (zoophyte), having the head and claws exposed. It is always found in the midst of sertulariæ, on which no doubt it feeds. It is very minute, and is represented both magnified and of the natural size.

Latreille places among the Amphipoda the genus Ione, regarded as one of the Isopoda by Desmarest, and of which the only known species, Ione thoracica, is parasitic, like Bopyrus, and hides itself under the carapace of the Callianassa subterranea, forming a tumour on one side. The female is always found accompanied by the male, which is of much inferior size. It appears to be a rare species. Montagu, who detected this crustacean in its retreat, drew it out, and kept it alive for some days; he describes it under the title of Oniscus thoracicus, in the 'Trans. Linn. Soc.' IX. iii. 3, 4. It is represented at Fig. 3245; *a*, the female; *b*, the male. The accompanying lines show its natural length.

ORDER LÆMODIPODA.

The Læmodipods form Latreille's fourth order of Crustaceans. As in the preceding the eyes are sessile, but the extremity of the body does not present any distinct branchiæ, and there is scarcely any caudal termination, the two last limbs being inserted at that end, where the segment serving for their attachment is only followed by one or two minute joints. The anterior limbs, moreover, which respond to the second jaw-feet, make a part of the head. Such are their distinctive characters. Latreille adds, that they have four setaceous antennæ, based on a three-jointed peduncle; the mandibles are without palps; a vesicular body is at the base of at least four pairs of limbs, commencing at the second or third pair; the body is almost linear or filiform, and with the head consists of eight or nine segments, with some small appendages in the form of tubercles, at its posterior and inferior extremity. The limbs are terminated by a strong hook. The four anterior feet, of which the second are the largest, are always terminated by a monodactylous claw. In many the following four are shortened, less articulated, without a terminal hook; or in a rudimentary and almost useless condition. The females carry their eggs under the second and third segments of the body, in a pouch formed by approximated scales (Latreille). According to M. Savigni these crustaceans approximate to the Pychnogonids, and with them form a link between the more typical groups and the Arachnids, or spiders.

To give an idea of the forms of these Læmodipods, we select two specimens. Of these, one is the Whale-louse, or Pou de la baleine, Cyamus Ceti, Fig. 3246. The figure is magnified so as to show the parts to greater advantage.

The other specimen is the Leptomera pedata, Fig. 3247. It is also magnified. This slender claw-limbed creature, with others allied to it, inhabits the seas of northern and temperate Europe. They reside among the fronds of sea-weed, and crawl like caterpillars, twisting their bodies about with great rapidity, and vibrating their long antennæ. In swimming they resemble shrimps.

ORDER ISOPODA.

Latreille, who established this order, observes that the Isopods approach the Læmodipods, as respects the absence of palpi or mandibles, but are removed from them in other details. The two anterior limbs are not affixed to the head, but, like those which follow, are attached to their own segment. They are always fourteen in number, unguiculated, and without any vesicular appendage at the base. The under surface is furnished with appendages which are very apparent, in the form of leaflets or vesicular sacculi; of these the two first, or most exterior, usually cover, either totally or in part, the rest. The body is mostly depressed, or broader than it is thick. The mouth is composed of the same parts as in the preceding crustaceans, but the portions which correspond to the two upper jaw-feet of the Decapods, have still more the appearance of a lower lip, terminated by two palpi. Two of the antennæ, viz., the internal, are almost obliterated in the lower forms of this order, which are all terrestrial, and have the respiratory organs accordingly modified. The females carry their eggs under the thorax, either between the scales, or in a pouch or membranous sac, which opens to afford a passage to the young. The latter are hatched with the form and parts characteristic of the species, and only change the skin according to their growth. The greatest number live in water; and those which are terrestrial have still the need, like other crustaceans which live remote from the liquid element, of a certain atmospheric humidity, in order that respiration may be carried on, and that the branchiæ may be preserved in a state propitious to this function. (Latreille.)

Of this order our pictorial specimens present us with many interesting forms, but into the minutiæ of which our limited space prevents us from entering. The first which we shall notice is a curious parasitic creature, which fixes its abode in the branchial chambers of the prawn, indicating its presence by a swelling on the side of the carapace of that crustacean, but which does not appear to be much incommoded by its intruding guest. This little parasite appears to derive its nutriment from the water circulating in the branchial cavity, and which, as we know, is replete with microscopic animalcules, and particles of animal matter. This species, the Bopyrus Crangorum, is represented at Fig. 3248: *a*, the upper side; *b*, the animal seen in profile; *c*, the under side; *d*, one of the feet much magnified; *e*, a small individual considered as the male, upper side; *f*, the same, lower side; *g*, the carapace of a prawn deformed on the right side by the presence of a Bopyrus.

We next turn to a genus which reminds us of those strange fossils known as Trilobites, and to which indeed Dr. Buckland conjectures the species are most nearly related. In the Trilobites, it is true, we can discover neither antennæ nor limbs, but these might have been very minute and fragile; perhaps the antennæ might, as in Bopyrus, have been wanting, and the limbs even more rudimentary; independently, however, of these, the eyes (which in the females of Bopyrus are absent) and the segments of the body approximate the Trilobites to the genus in question, namely Serolis. Desmarest, indeed, will not admit of any resemblance or affinity between Serolis and the Trilobites; but we cannot avoid leaning to the opinion of Dr. Buckland, not that we mean to say that the forms are identical, but they have decided points of relationship.

The Serolis Fabricii (Cymothoa paradoxa, Fabricius). Fig. 3249, is found on the coasts of Tierra del Fuego, and the straits of Magalhaens. Capt. P. P. King, R.N., observed it on the coast of Patagonia, and at Port Famine, where the beach was covered with dead specimens. He observed numbers of them alive also, among sea-weed at the bottom of the water, where they moved about slowly and gradually, their limbs appearing to be adapted for crawling and swimming in a quiet manner, very different from that of the shrimp. Referring to Fig. 3249, *a* shows the back; *b*, the under surface; *c*, a magnified view of the branchiæ attached to the abdominal limbs.

Among other forms, we may refer to Cymothoa, of which Cymothoa Œstrum (Fig. 3250) is an example; *a*, the upper side; *b*, the lower side. The last section is broad and paddle-shaped.

Another allied genus is Canolira of Leach, of which the Canolira Capensis (Fig. 3251) is an example.

Related to the preceding is the genus Æga of Leach, represented by the Æga emarginata, Fig. 3252. *a*, upper side; *d*, under side; *b*, anterior foot; *c*, posterior foot. To this succeed several other genera, of which one is termed Nelocira, Leach. It is represented by the Nelocira Swainsonii, Fig. 3253.

While passing cursorily over the genera of this order, we pause for a moment at Limnoria, of which that formidable species, the Limnoria terebrans, is well known from the ravages it commits. This little Isopod, though only two lines in length, is a formidable pest. It pierces the timbers of ships, and the piles and woodwork of piers, with wonderful rapidity, and as thousands work together, the extent of mischief produced in a short time is very considerable. When disturbed, it rolls itself up like a woodlouse. This injurious crustacean is spread through the seas of Europe.

To another section of the Isopods belong several genera, as Sphæroma, Næsa, Cilicæa, &c.

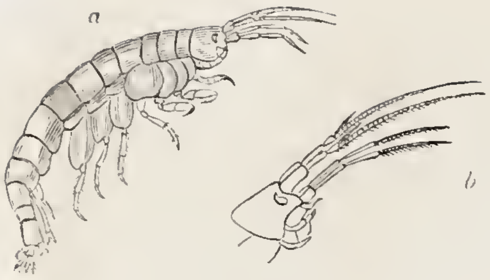
Of the genus Sphæroma, the Sphæroma dentata (Fig. 3254) is an example.

Of the genus Næsa, the Næsa bidentata is represented at Fig. 3255.

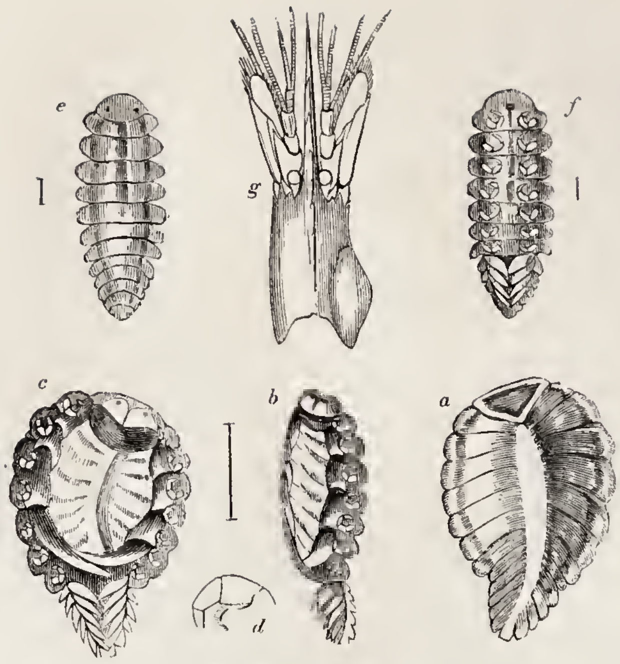
The genus Cilicæa presents us with the C. Latreillii, Fig. 3256.

Closely allied to the preceding is Cymodocea, of which the Cymodocea Lamarckii is an example (Fig. 3257). These genera have a broad and somewhat oval form of body and moderately long antennæ, but in Anthura the body is slender, the antennæ short, and the caudal fin small, the lateral leaflets being shorter than the central paddle.

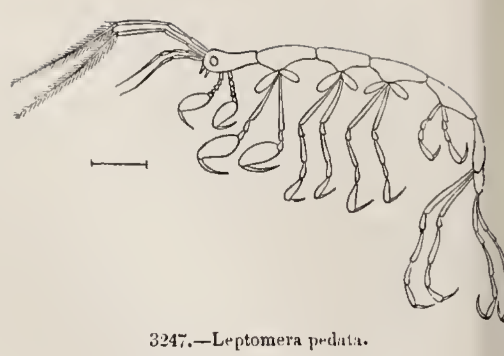
Fig. 3258 represents the Anthura gracilis, magni-



3241.—Gammarus Pulex.



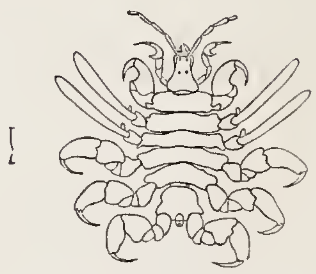
3248.– Bopyrus Crangorum.



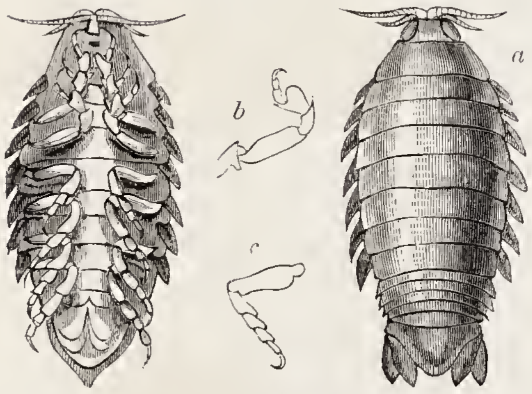
3247.—Leptomera pedata.

3243.—Melita palmata.

3242.—Atylus carinatus.

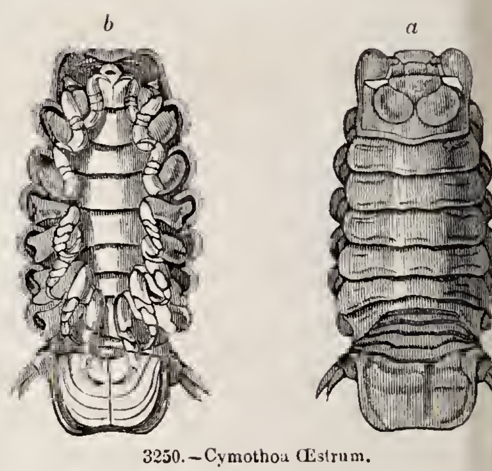


3246.—Whale-Louse.

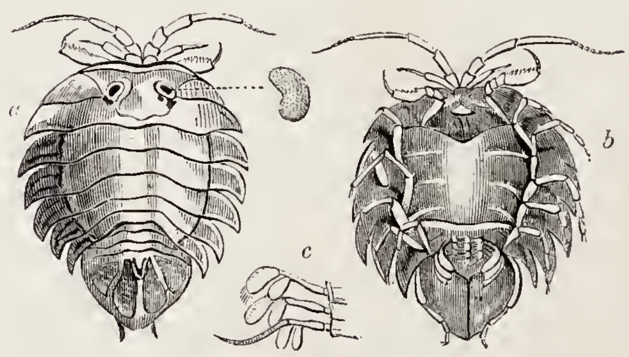


3252.—Æga emarginata.

3255.—Næsa bidentata.

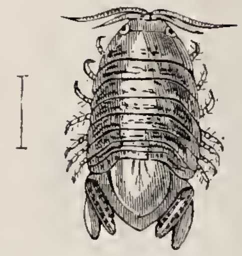


3250.—Cymothoa Œstrum.

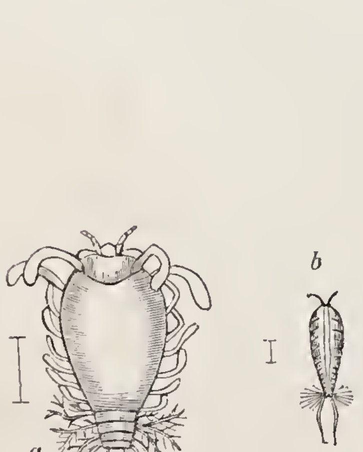


3249.—Serolis Fabricii.

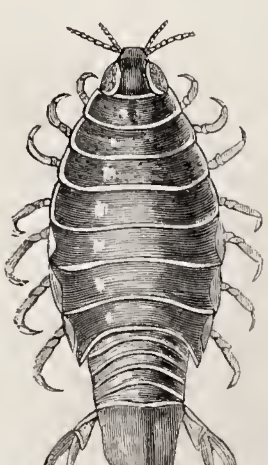
3253.– Nelocira Swainsonii.



3254.—Sphæroma dentata.

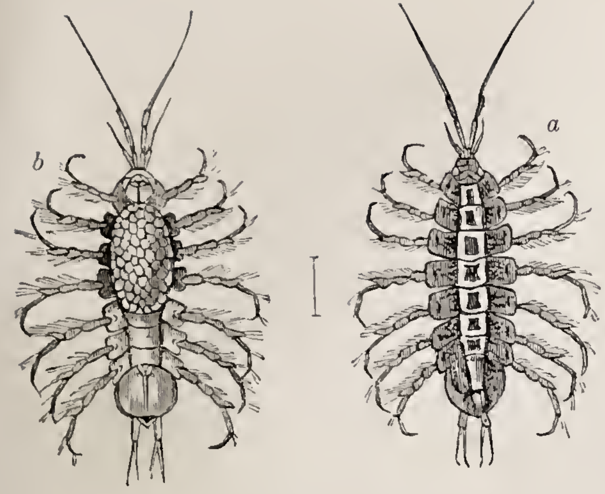


3245.—Ione thoracina.

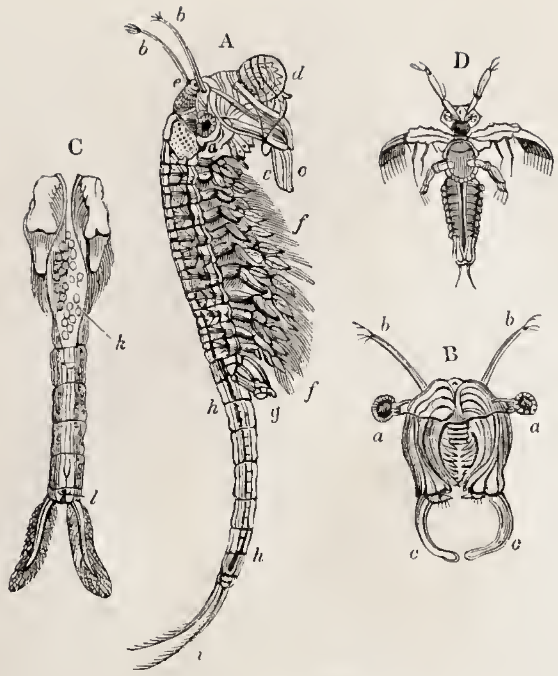


3251.—Canolira Capensis.

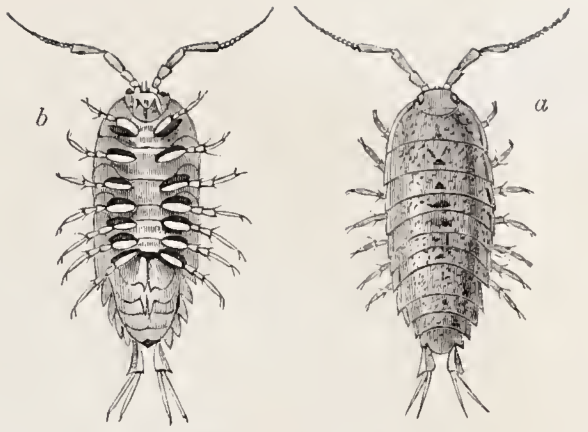
3244.—Cerapus tubularis.



3261.—Asellus aquaticus.

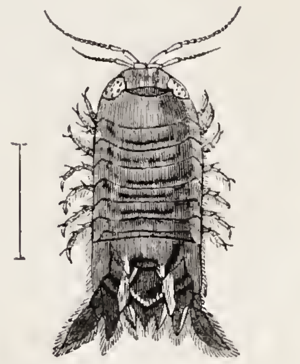


3275.—Brine Shrimp or Brine Worm.

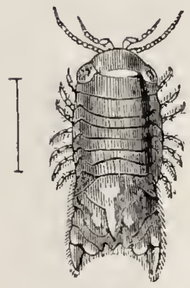


3262.—Ligia oceanica.

3263.—Common Woodlouse.

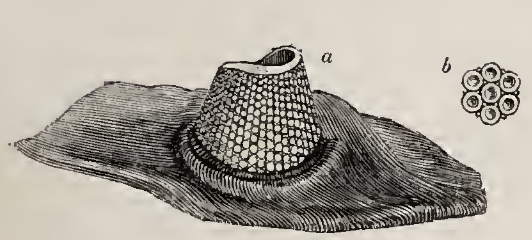


3257.—Cymodocea Lamarckii.

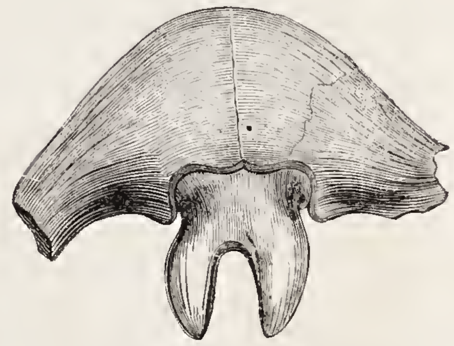


3256.—Cilicæa Latreillii.

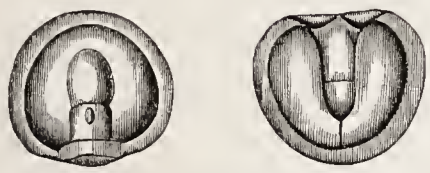
3259.—Idotea tricuspidata.



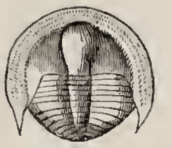
3266.—Eye of Asaphus caudatus.



3267.—Part of Shield of Asaphus platycephalus.

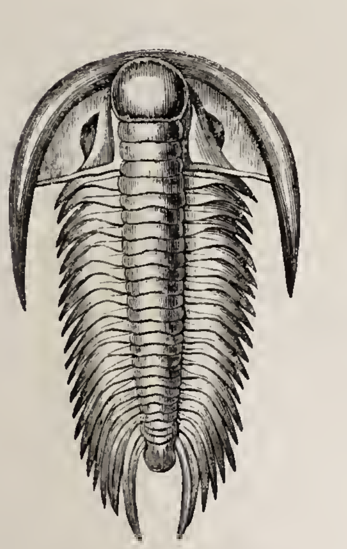


3272.—Agnostus pisiformis.

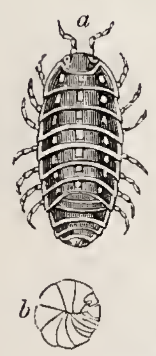


3271.—Trinucleus Lloydii.

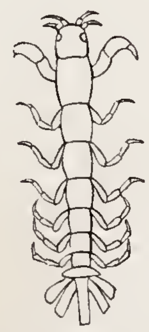
3269.—Calymene Browuingii.



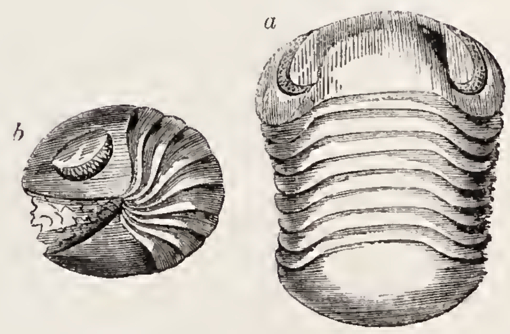
3270.—Paradoxoides Tessini.



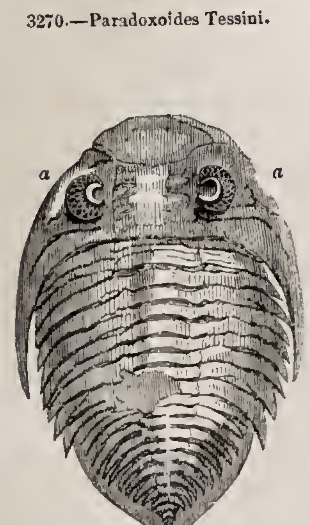
3264.—Common Armadillo.



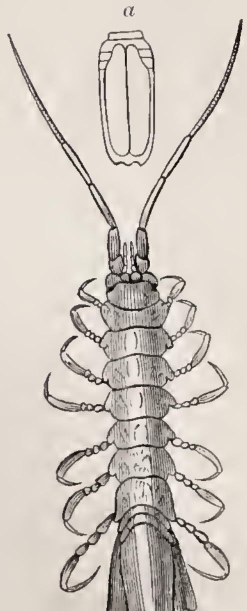
3258.—Anthura gracilis.



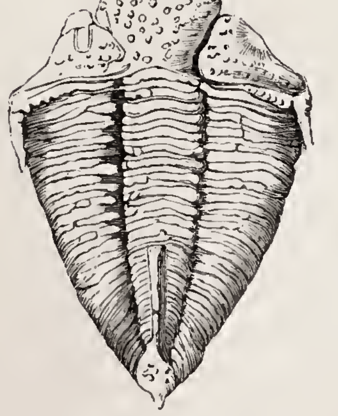
3268.—Nileus Armadillo.



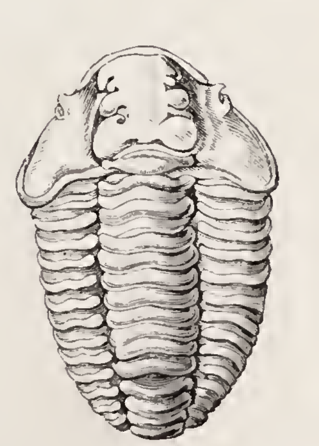
3265.—Asaphus caudatus.



3260.—Stenosoma lineare.



3274.—Trilobite.



3273.—Trilobite.

fied. The following genera form a family group called Idoteidæ. The branchiæ are in the form of bladders capable of being inflated, and covered by two blades or valvules of the last segment, to the sides of which they are affixed. The tail is formed of three segments, the last of which is the largest, without appendages at the end or lateral fins. All are marine. In the genus Idotea the feet are strongly unguiculate. Fig. 3259 represents the Idotea tricuspidata.

The genus Stenosoma differs principally in the great length of the lateral antennæ. The Stenosoma lineare (Fig. 3260) is an example. *a*, laminæ of the under part of the abdomen.

Passing over one or two genera we come to Asellus, the representative of a distinct family group, Asellota. In the genus Asellus there are two bifid slender filaments at the caudal extremity of the body. The two central antennæ are long, the two others as long as the peduncles of the former. The feet are unguiculate, and fringed. The Asellus aquaticus is represented at Fig. 3261. The specimens are those of a female magnified; the line between is the natural length. *a*, upper side; *b*, under side.

This singular Isopod is a native of fresh water, and is abundant in stagnant pools, or slow-moving drainage courses; we have found it in plenty in sluggish drains, buried in the mud, or among decomposing masses of leaves and herbage. It is by no means rapid in its aquatic movements, but when disturbed buries itself very promptly; it remains in a state of torpor during the winter, thus protected in its retreat from the severities of the season. In the spring it emerges, and returns to active existence. The male exceeds the female in size. The eggs of the latter are contained in a membranous sac placed between the limbs under the chest, and this sac opens by a longitudinal slit to give passage to the young. It appears to feed on decomposing animal and vegetable matters.

We now come to another family group termed Oniseidæ, of which the ordinary woodlouse is the type.

In this family the antennæ are indeed four, but the two intermediate ones are extremely minute. The tail is composed of six segments, with either two or four needle-shaped appendages at the posterior border of the last segment, which has no lateral fins. Some species are aquatic, others terrestrial; and in the latter the first leaflets below the tail exhibit a row of small holes where the air penetrates to the organs of respiration there inclosed.

In genus Ligia, the stem of the lateral antennæ is composed of a great number of small joints, and the caudal stylets are bifid.

The Ligia oceanica (Fig. 3262) is common on the sea-coast, and may be seen creeping about on rocks or the parapets of marine structures; when disturbed it folds up its limbs and lets itself drop. It closely resembles the woodlouse in appearance, but is larger, being an inch in length; its colour is grey with two large yellow marks on the back. *a* shows the upper surface; *b*, the under surface, natural size. The Ligia Italica, and Ligia Hypnorum, are allied species.

We now come to the genus Oniscus, of which the ordinary Woodlouse, or Cloporte of the French, is an example.

In this genus the lateral antennæ have eight joints, and the two external appendages of the tail are longer than the two intermediate.

Fig. 3263 is the common Woodlouse, Oniscus murarius. This species is abundant in damp or humid places, secreting itself during the day under stones, beneath the bark of mouldering logs or trees, in the holes of walls, in the ground at the base of garden pales, in cellars, &c. They creep abroad during the hours of darkness, in search of decomposed animal and vegetable matters, on which they feed; and retire on the approach of dawn. Their movements are by no means rapid, and when alarmed and unable to escape they double themselves up, but do not form a complete ball. The eggs are inclosed in a pouch beneath the chest. The young when excluded have a thoracic segment short, and consequently only six pairs of limbs, instead of seven. These animals were formerly used in medicine, but have been long rejected from the materia medica. Latreille separates from the genus Oniscus such woodlice as have only seven joints in the lateral antennæ; of these he forms the genus Porcellio. We may notice as examples the Cloporte ordinaire, var. C. Geoffroy, Oniscus asellus of authors; and the Cloporte ordinaire, var. B. Geoffroy, Porcellio lævis, Latr.

In the allied genus Armadillo, the animals have the power of rolling themselves up into a complete little ball; the posterior appendages of the body are not projecting, and the last segment is triangular. The lateral antennæ have only seven joints; the upper subcaudal scales are pierced with a row of small orifices.

The common Armadillo, A. pustulosus (Fig. 3264), is well known, inhabiting the same situations as the woodlouse, and remarkable for its habit of rolling itself up into a little motionless ball when touched. It is the Oniscus Armadillo of Linnæus, the Oniscus cinereus of Panzer, the Armadille pustulé of Desmarest; but not the Oniscus pustulatus of Fabricius and Panzer, which is the Glomaris marginata of Leach, and the Iulus ovalis of Linnæus, one of the Millepedes. (Myriapoda.)

Referring to Fig. 3264, *a* shows the Armadillo pustulatus expanded; *b*, rolled up.

Here, then, with these well-known terrestrial creatures so familiar to all, we may close our sketch of the Isopoda; but perhaps we cannot select a more appropriate place for arranging our pictorial specimens of the Trilobites, singular forms known only in their fossil state, and to which we have already alluded.

M. Latreille considers the Trilobites as related to the King-Crabs (Xiphosurus), and Mr. MacLeay regards them as constituting a distinct order intermediate between the Isopods and some of the Entomostraca, as for example Apus. "If," says Mr. MacLeay, "the Trilobites are once demonstrated to have possessed articulated feet, it will be difficult to remove a male Bopyrus from the group. Here the two eyes are placed on the back of the head, and wide apart. Here also there are no antennæ, no posterior lateral abdominal appendages, and besides no very distinct articulation to the sternum. If the Bumastus (a trilobite) of Murchison had a body of thirteen equal segments, with short crustaceous feet, it would be a male Bopyrus, so close is the affinity. (See Fig. 3248.) The differences between a male and female Bopyrus, such for instance as the presence of eyes in the former, and the want of them in the latter, may also induce us to fancy that similar resemblances may possibly have occurred between certain male and female Trilobita, which from their primâ facie difference of form are now placed in distinct genera, though they may have truly belonged to one and the same species."

The Trilobites (called Dudley Fossils, Entomolithus paradoxus, &c.) are found in certain strata, throughout every part of the globe. They occur, says Dr. Buckland, all over Northern Europe and in numerous localities in North America; in the southern hemisphere, they occur in the Andes and at the Cape of Good Hope. "None have been found in any strata more recent than the carboniferous series, and no other crustaceans, except three forms which are Entomostracous, have been noticed in strata coeval with any of those that contain the remains of Trilobites; so that during the long periods that intervened between the deposition of the earliest fossiliferous strata and the termination of the coal formation, the Trilobites appear to have been the chief representatives of a class which was largely multiplied into other orders and families, after these earliest forms of marine crustaceans became extinct."

In our country the transition limestone of Dudley affords many interesting species of Trilobite, and the form occurs in the black marble at Ashford in Derbyshire, but is very rare.

As already observed, whether the trilobites possessed antennæ and limbs is yet undecided; they were, however, provided with highly organized instruments of vision,—simple as it would appear in Bumastus, but compound in the rest.

Dr. Buckland remarks that the eyes of Trilobites deserve peculiar consideration, as affording the most ancient and almost the only example yet found in the fossil world of the preservation of parts so delicate as the visual organs of animals that ceased to live many thousands and perhaps millions of years ago; indeed, we must regard those organs with feelings of no ordinary kind, when we recollect that we have before us the identical instruments of vision through which the light of heaven was admitted to the sensorium of some of the first-created inhabitants of our planet.

According to Dr. Buckland each eye of Asaphus caudatus contains at least four hundred nearly spherical lenses fixed in separate compartments on the surface of the cornea, and he observes that the form of the general cornea is peculiarly adapted to the uses of an animal destined to live at the bottom of the water: "to look downwards was as much impossible as it was unnecessary to a creature living at the bottom; but for horizontal vision in every direction the contrivance is complete. The form of each eye is nearly that of the frustrum of a cone, incomplete on that side only which is directly opposite to the corresponding side of the other eye, and in which, if facets were present, their chief range would be towards each other across the head, where no vision was required. The exterior of each eye, like a circular bastion, ranges nearly round three-fourths of a circle, each commanding so much of the horizon, that where the distinct vision of one eye ceases that of the other eye begins; so that in the horizontal direction the combined range of both eyes was panoramic." Dr. Buckland then refers to the modifications of the same mechanism in the existing Branchipus, Serolis, and Limulus, according to their habits, and remarks that we find in Trilobites of the transition rocks, which were among the most ancient forms of animal life, the same conformation of the eye which is at present adapted to similar functions in the living Serolis.

Fig. 3265 represents the Asaphus caudatus, from Dudley, with the eyes, *a*, *a*, well preserved.

Fig. 3266 shows at *a*, a side view of the left eye of the same highly magnified; *b*, a magnified portion of the eye of Calymene macrophthalmus. Most, if not all the Trilobites, had the power of rolling themselves up somewhat in the manner of a woodlouse; in this position the head was not concealed, but toad-like, surmounted the ball or hinder segments, curled round, producing a grotesque effect. Of what extent of locomotion they were capable, we are unable to say with certainty.

Referring to our pictorial specimens, Fig. 3267 represents the under surface of the anterior portion of the shield of Asaphus platycephalus, from Lake Huron.

Fig. 3268 is the Nileus Armadillo: *a*, seen from above; *b*, profile, the animal rolled up.

Fig. 3269, Calymene Browningii, partially rolled up.

Fig. 3270, Paradoxoïdes Tessini.

Fig. 3271, Trinucleus Lloydii.

Fig. 3272, Agnostus pisiformis, one of the anomalous Trilobites of Battoïds, which differ in many points from the true Trilobites, and are as yet but very imperfectly known. The fossils resemble small and nearly circular bucklers of two kinds; and M. Brogniart considers them to have covered the whole of the body, but M. Dalman to have belonged some to the head, others to the abdomen of a Trilobite, the thorax of which was rudimentary.

Figs. 3273, 3274, two species of Trilobite.

SECTION ENTOMOSTRACA.

The Entomostracous Crustaceans are all aquatic and for the most part inhabitants of fresh water; many are microscopic. They chiefly abound in stagnant pools or sluggish streams, yet the purer rivers and fountains are not without their species. Microscopic plants and animalcules are their food, including the dead of their own race; and they in turn are the prey of the Hydra, and of aquatic larvæ. Many, as the Cyclops, common in every ditch, undergo singular transformations in their progress from the egg to maturity.

The females of many species carry the eggs in a sac or in sac-like appendages, and in Apus the eleventh pair of legs have their first joints expanded into two discs, which closing together form a sort of bivalve chamber in which the eggs are contained.

Latreille divides the Entomostraca into the following orders and tribes:

Order Branchiopoda. or Tribes	Sections	{ Lophyropa. Phyllopa.
Order Pæcilopoda		{ Xyphosura. Siphonostoma.

The Lophyropa are divided into—1st, Carcinoida, with one eye, as Cyclops; with two eyes, as Zoea: 2nd, Ostracoda or Ostrapoda, with one eye, as Cypris; 3rd, Cladocera, as Daphnia.

The Phyllopa are divided into—1st, Ceratophina, as Branchipus; 2nd, Aspidophora, as Apus.

The Xyphosura are not divided; as we shall see, they constitute an order or sub-class per se.

The Siphonostoma are divided into—1st, Caligians, as Argulus, Caligus, &c.; and 2nd, Lernæiformians, as Nicothoe, &c. The arrangement of Milne Edwards differs considerably and may be summed up as follows.

Branchiopoda.—No true branchiæ, but the thoracic extremities lamellar, membranous, and respirative. Orders:—1. Phyllopoda: no bivalve shell-like covering, limbs natatory, from eight to eighty-two. (Ex. Branchipus, Phyllopus, Apus.) 2. Cladocera: carapace like a bivalve shell, thoracic limbs five pairs. (Ex. Daphnia, &c.)

Entomostraca (proper).—No branchiæ nor any apparent respiratory organs; eyes sessile, united into a single mass. Orders:—1. Copepoda: body divided into distinct rings, neither carapace, nor valvular shell; thoracic and oral members numerous. (Ex. Cyclops.) 2. Ostrapoda: body without evident annular divisions, inclosed in a bivalve shell; limbs few. (Ex. Cypris, Cytherea, &c.)

Haustellata (Suctorial crustaceans).—Orders: —1. Aranæiformes: extremities rod-like, long, and adapted for walking. (Ex. Pychnogonum, Nymphon.) 2. Siphonostomata: extremities not adapted for walking; partly lamellar, partly prehensile. (Ex. Dichlestion, Argulus, Nicothoe, &c.) 3. Lernæiformes: extremities rudimentary; body presenting abnormal forms. (Ex. Lernæa, &c.)

We shall pursue the outline of these crustaceans by observations on the pictorial specimens before us, leaving our reader to adopt either of the above arrangements, of which that given by Milne Edwards is generally preferred. Fig. 3275 is the Brine shrimp or Brine worm (Branchipus stagnalis, Cancer salinus, Linn.). This singular little creature is about half an inch in length, and very transparent. It abounds in myriads in the brine pans at Lymington, in which the water contains about a quarter of a pound of salt to a pint of fluid. It is also found in some of the salt lakes in Siberia. It swims about with great rapidity, and is in continual motion, revelling in a solution of salt so concentrated as to destroy most marine creatures instantly. The workmen at the Lymington salterns consider this little shrimp as essential to the purity of the water, and are anxious to promote their increase. These crustaceans undergo remarkable changes in their progress from the egg to maturity, as was observed by Mr. Thompson, whose valuable account is published in the 'Zool. Researches' for 1834. Referring to Fig. 3275:—A exhibits the male magnified; *a a*, composite or network eyes; *b*, antennæ; *c c*, mandibuliform horns; *d d*, proboscidiform moveable tentacula rolled spirally; *e*, simple rudimentary eye; *f f*, leaf-like natatory feet; *g*, essential parts; *h h*, tail; *i i*, terminating filaments: B, front view of head: C, tail of female; *k*, egg-pouch; *l*, end of egg-duct: D, a young specimen after the first moult.

Among the Phyllopodous Entomostracea is the genus Apus, of which the Apus productus, Fig. 3276, is an example. We have already referred to it in our observations on the Trilobites. These little creatures (Monoculus, Linn.) are found in ponds and ditches, where they often swarm in myriads, and have been known to be carried up by violent storms of wind and scattered over the land; hence they often appear suddenly in accidental rain-water puddles, and in water where none have been previously, especially in the spring and commencement of summer. Their food consists principally of tadpoles; they swim well on the back, and when they bury themselves in the mud they keep the tail elevated. On exclusion from the egg, the young have only a single eye, and four oar-like limbs; the body is tailless, and the shell forms a simple undivided carapace. The perfect form is obtained by successive moults. These creatures are the common food of the Wagtails (Motacilla).

We may next allude to that curious little microscopic creature the Daphnia Pulex, often present in stagnant waters in such myriads congregated together as to give the water the colour of blood. Their moults are very frequent, and the females produce several generations in the course of the summer. All are supposed to perish when the frost of winter sets in, but the eggs remain uninjured and are hatched by the genial warmth of spring, the pools becoming suddenly replete with countless swarms of these active animalcules.

Another singular species, the Cyclops vulgaris, Fig. 3277, remarkable for the transformations it undergoes, is common in fresh water. On each side of the tail of the female is a pellucid oval sac, filled with eggs, the number of which increases with age; these sacs are replenished eight or ten times in the course of three months; and as the female begins to lay at an early age, supposing the average number of eggs to be forty each time, the multitude of which a single individual will during six months be the progenitor is enormous. The young at their birth have only four feet, and the body is rounded and tailless; in due time other limbs appear, and after a few moults the tail is developed. The eye is single.

These animalcules resist cold with singular power; they have been frozen in water congealed by ice, which on melting was full of them active as ever; some however perished. They will also endure to be dried, but not for many minutes. Jurine found that out of twelve individuals dried for fifteen minutes, five only recovered on being restored to the water; and that of twelve kept dry for twenty-five minutes, all perished.

Yet as in seasons of drought the pools and ditches are dried, it most probable that they will retain life buried in the mud as long as any moisture remains. The eggs, according to Strauss, do not perish, even should the parents, but become hatched in the course of four or five days when the pools are replenished. These creatures grow and change their shells or transparent horny investment like the crab or lobster, the frequency of the exuviations depending on the season of the year and the gradual development of the body. The change of the shell is very complete; not only does the investment of the body become thrown off, but the outer layer of the fine branchiæ and the minutest hairs on the antennæ. This species is about eight-twelfths of a line in length, and is subject to several variations of colour, being reddish, greenish, or grey. Referring to the figure (3277), A represents the male; B, the female; *a a*, antennæ; *b b*, parts at the base of the tail in the male; *d d*, internal egg-organs; *c c*, external egg-sacs: C, female, variety: D, a young Cyclops.

Fig. 3278 represents Zoea clavata. This singular animalcule is affirmed by Mr. Thompson to be the young of a species of crab, after exclusion from the egg. He states that in several genera, as Cancer, Carcinus, Portunus, &c., observed by himself, the young appears under this form. On the contrary Rathke, Milne Edwards, and Mr. Westwood deny the correctness of Mr. Thompson's observations. (See the 'Zool. Journal,' vol. v.) The question is still in abeyance.

In the genus Cypris, the animal is inclosed in a minute transparent bivalve shell, of a horny texture, and not unlike that of a mussel in miniature; the two valves are united by a hinge, and capable of being closed so as to secure the inhabitant. The animal has six limbs, and two long setaceous antennæ. These creatures inhabit fresh waters and gently-running streams, and swim with more or less celerity as they bring the filaments of the antennæ into play, and the two anterior limbs. They are capable also of creeping over the leaves of aquatic plants. Whether they undergo any metamorphosis is very doubtful; the eye is single. Their food consists of dead animal and vegetable matters. In habits and manners they closely resemble the Cyclops, and remain torpid in the moist mud during the droughts of summer, regaining their activity when the rains set in.

The Cypris ornata, Fig. 3279, is about a line or little more in length; its shell is yellowish green, with pure green bands commencing at the eye. A, a side view of the shell magnified; B, a view of the hinge.

Fig. 3280 represents a smaller species, Cypris fusca, with one shell removed to show the internal organization: *a a*, the outline of the valve; *b*, the origin of the hinge membrane; *c*, the eye; *d d*, antennæ deprived of their bristles; *e*, feet of the first pair; *f*, feet of the second pair; *g*, of the third pair; *h*, the tail, used for cleaning out the inside of the shell; *i*, labrum; *k*, mandible; *l*, feeler; *m*, jaw of the first pair; *n*, of the second pair; *o*, branchia; *p*, *q*, posterior portion of the egg-sac; *r*, insertion of a tubular vessel.

We now pass to the suctorial crustaceans, creatures which have the mouth adapted for sucking the juices which they obtain from other animal bodies; they are therefore essentially parasitic; their forms are extremely variable, and all appear to undergo several transformations in their progress from their birth to maturity. The Araneiform species, or Pychnogonids, are by many referred to the Arachnids, or spiders, and it is not without doubt that Milne Edwards places them within the pale of the Crustaceans; they have, however, no tracheæ, or pulmonary sacs, the integuments most probably serving the office of branchiæ. These creatures are of small size, with long limbs, and a body divided into segments. They mostly take up their abode under stones along the coast, in the water, and sometimes they are said to be found hooked on to fish or other marine animals.

Fig. 3281 represents the Pychnogonum littorale magnified: *a*, one of the hooked feet still more enlarged.

To the Siphonostomatous group is referable that curious parasite Caligus Mulleri, Fig. 3282, found adhering to the gill-covers of the codfish. It holds on by means of the hooks which terminate the anterior pairs of limbs; and beneath the head is an obtuse beak, through which it sucks up its nourishment. The terminal prolongations are by some supposed to fulfil the office of branchiæ.

Another form is exhibited by the Phyllophora, remarkable for the lamellar appendages with which the back is covered. These creatures, like many others allied to them, live upon fishes, but not permanently; they can let go their hold and change their place either by swimming or slowly crawling; Fig. 3283 represents the Phyllophora cornuta, from Tongataboo: *a*, the under surface.

Passing over numerous genera, we come to the Lerneiform section, remarkable for the singularity of their appearance. When young they resemble the young of Cyclops, and are then provided with a frontal eye and natatory limbs, swimming with facility; but having undergone a certain number of moults, they cease to lead an erratic life. The limbs, now no longer needed, become lost, or waste away, the eye mostly disappears, and the body assumes a strange form. The female is at this stage found fixed to some fish or aquatic animal, with the male clinging closely to her. They are soldered, as it were, to their victim by means of various cutaneous appendages, or, in some cases, moveable arms.

Fig. 3284 represents a species of Chondracanthus (Ch. cornutus) found on various kinds of flat-fish: *a*, the female magnified, with the double egg-sac: *b*, the male in profile, highly magnified; *c*, the same seen from below; *d*, the head of the female seen from below; *e*, the mouth.

A still more remarkable form is found in Achtheres, Tracheliastes, &c. They are covered with a dense horny but transparent investment. In the females the thorax gives origin to two large arms, which bend forwards like horns, and meet, the points united together forming a cup-like sucking disc. There are two pairs of hooked jaw-feet for close adhesion. The achtheres is found on the perch, and is not a quarter of an inch in length. The Tracheliastes polycolpus, Fig. 3285, is found on the fins of the chub: *a*, the female magnified seen from above, with the two egg-sacs; *b*, the same seen laterally and deprived of the egg-sacs; *c*, the anterior extremity of the body more highly magnified; *d*, appendage representing the second pair of hooked jaw-feet; *e*, mandible; *f*, the first stage of this animal; *g*, the same in the second stage.

Passing by Lernæa, Lerneocera, Penella,* &c., we pause at Lerneonema. Of this genus one species, Lerneonema monilaris, Fig. 3286 (magnified), is found attached to the eye of the sprat. The whole head of the parasites of this and several allied genera is plunged into the tissue of the sufferer, and retained, like an arrow, by barbs or horny prolongations.

Fig. 3287 shows several of these creatures (the Lernæa spratti of Mr. Sowerby) attached to the fish in question. The Lerneonema monilaris, or sprat Lernæa, is luminous at night; the fishermen state that a shoal is often headed by several fish thus infested, and they call them Lanthorn Sprats.

Here we close our sketch of the suctorial crustacea as arranged by Milne Edwards. Cuvier places the Lerneans among his Vers intestinaux cavitaires, and other anatomists in a class to which they give the title of Epizoa, in allusion to their external parasitic mode of life; and though we have here adopted Milne Edwards' arrangement, we think the class Epizoa to be founded upon solid grounds. It may be observed that in Cuvier's arrangement the little Nicothoe, so abundant on the gills of the lobster, is placed among the Siphonostomata.

There is a most interesting group of crustaceans, constituting a distinct subclass, which we have purposely refrained from describing. It is termed by Milne Edwards the

SUBCLASS XIPHOSURA.

In this curious form we find the haunches or basal joints of the thoracic limbs bristling with short stout spines, serving the office of jaws for crushing and grinding the food forced by their action into the mouth, which they surround. If we look at one of these strange crabs from above, we see no limbs, all being covered by a very convex buckler, divided into two parts, viz., a cephalo-thoracic buckler, and an abdominal buckler, to which is added a long caudal spine. The first buckler is rounded in front, and deeply notched posteriorly for the reception of the base of the abdominal shield, which is serrated along each side, each interval between the teeth having a moveable spine. The eyes are four in number, two large and oval, with numerous facets situated laterally each on the outer side of a kind of broad median keel on the first buckler: the two other eyes are simple, small, and placed close together at the anterior extremity of the keel.

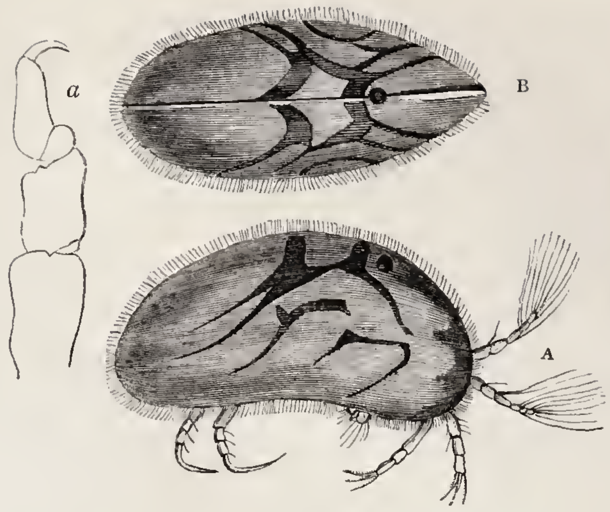
The thoracic limbs consist of six pairs; the first pair are much smaller than the others and placed anteriorly to the mouth. The subsequent limbs are well developed, and all terminating in pincers, excepting the foremost pair of these in the males, which end in simple points. They are composed of six joints, of which the basal ones are armed with spines and serve as jaws; but the basal joint of the sixth pair terminates on the inside in a toothed surface, and carries at its external angle a flabelliform appendage. The abdomen is hollowed deeply, and carries six pairs of false feet; of these the first pair are united into one broad valvular piece, which shuts down over the rest so as to protect and cover them. The succeeding false feet are also foliaceous, and united together down the median line; they are branchiferous, each foot carrying on its external edge a large foliaceous gill, formed of cutaneous laminæ disposed transversely, and piled one on the other like the leaves of a book. The caudal spike is stout, sharp, and moveable.

This subclass contains only one generic group, viz., Limulus. The Limuli or Xiphosures undergo great transformations in their progress from the egg to maturity; they are natives of the Indian and Japanese seas, and also some parts of the coasts of America, within the northern hemisphere. They frequently come ashore, traversing the flat sandy beaches, and look like self-moving shields, none of

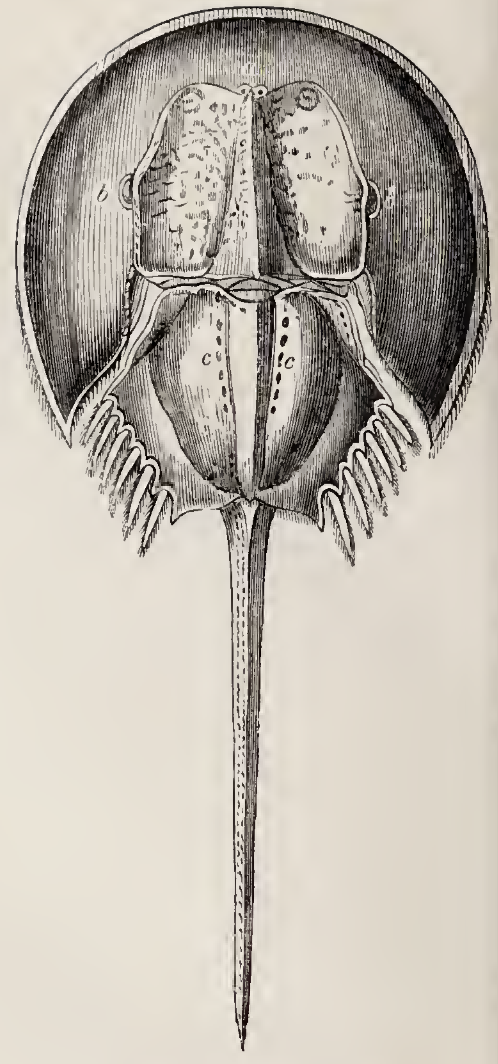
* The Penella filosa buries itself in the flesh of the swordfish, tunny, &c., and torments them horribly, being seven or eight inches long.

3276.—Apus productus.

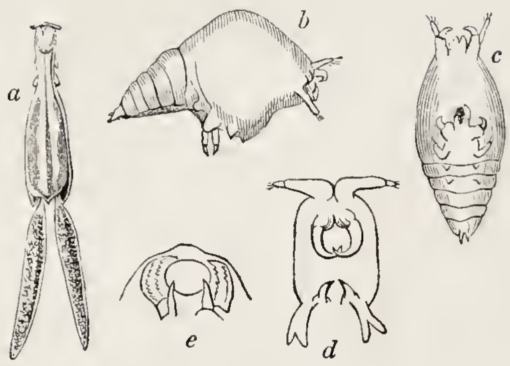
3281.—Pychnogonum littorale.



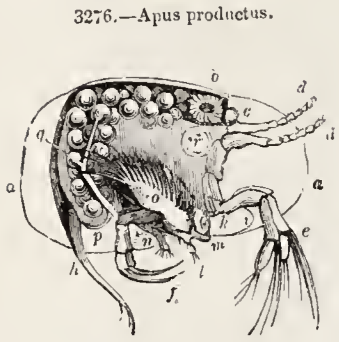
3279.—Cypris ornata.



3288.—Limulus Nolucanus.



3284.—Chondracanthus cornutus.

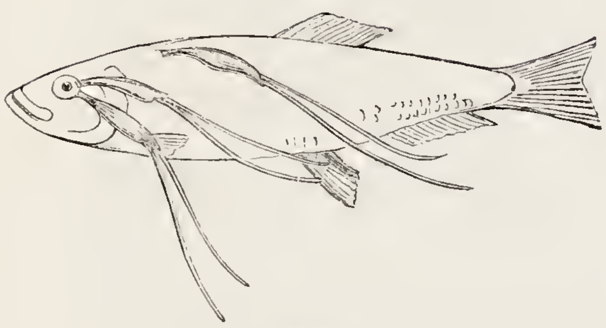


3280.—Cypris fusca.

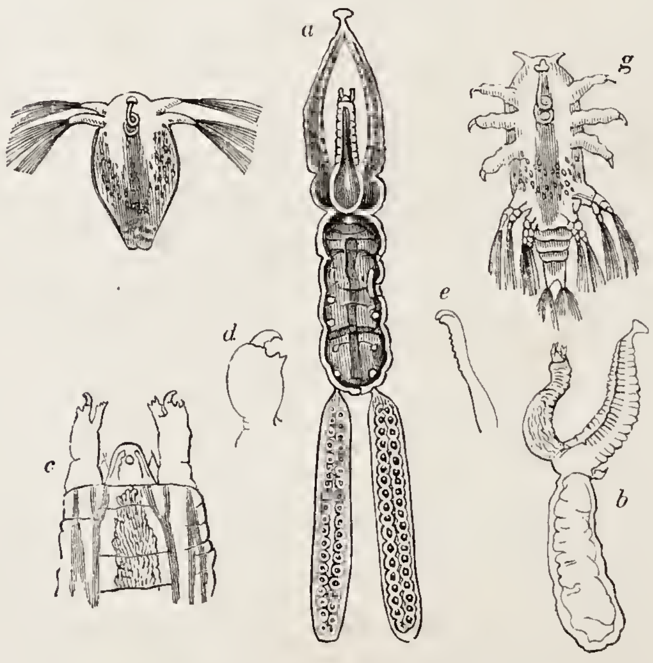
3282.—Caligus Mulleri.

3286.—Lerneonema monilaris.

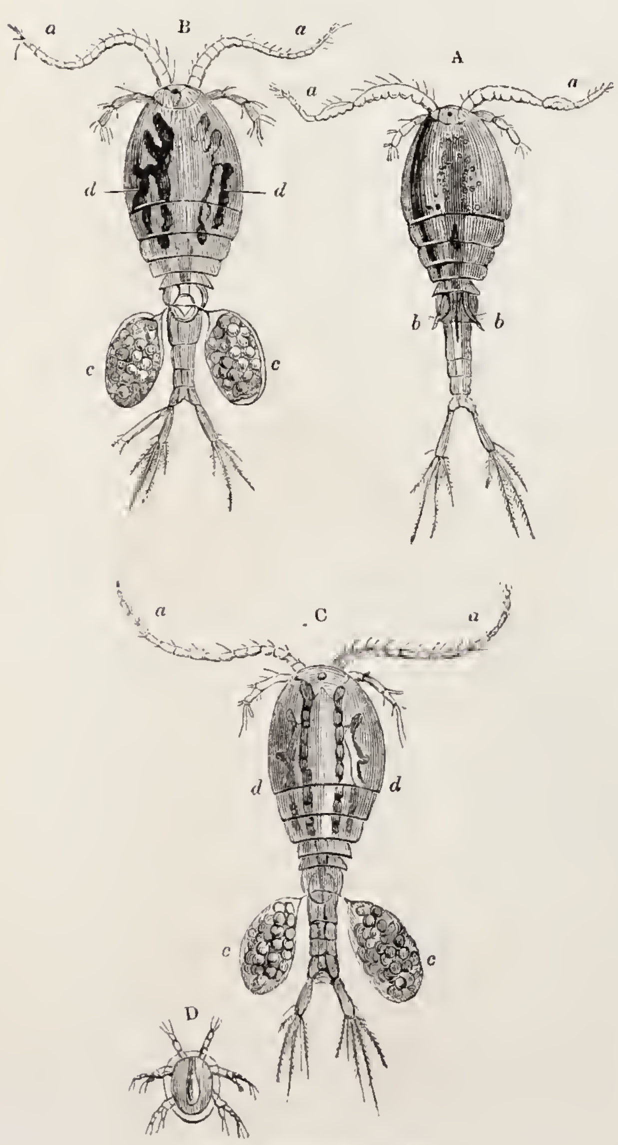
3278.—Zoea clavata.



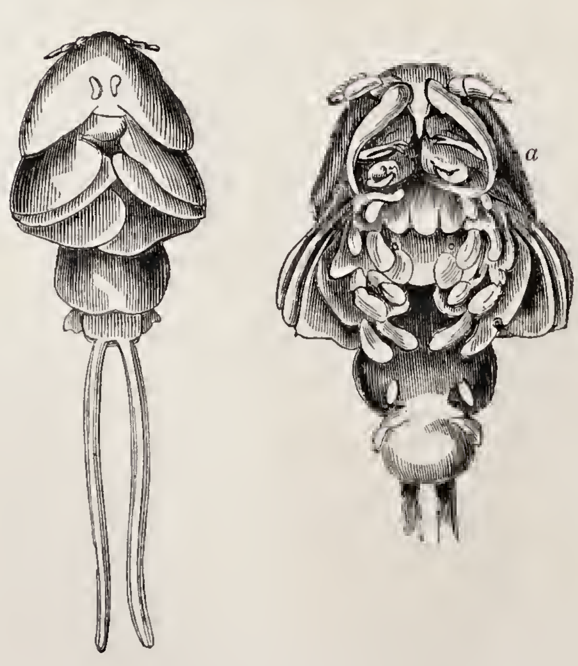
3287.—Lerneans on Sprat.



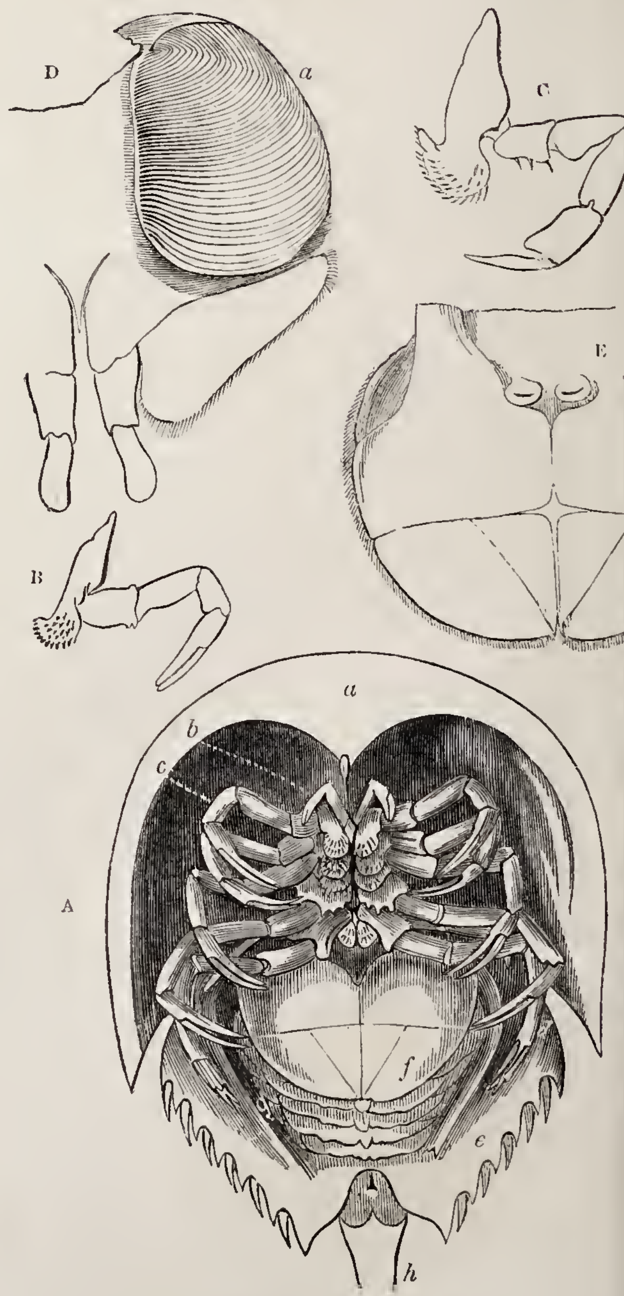
3285.—Tracheliastes polycolpus.



3277.—Cyclops vulgaris.

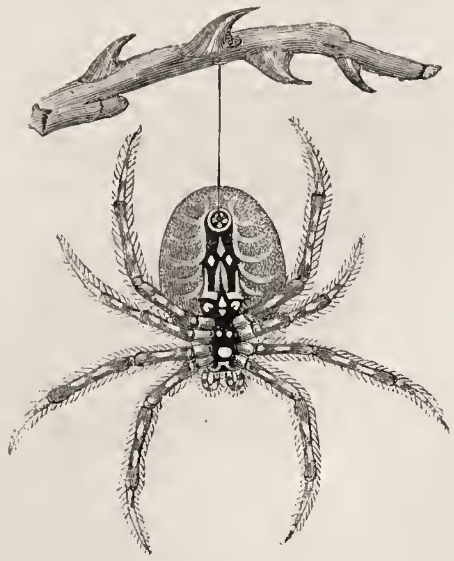


3283.—Phyllophora cornuta.



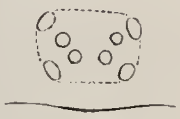
3289.—Limulus rotundicauda.

3314.—Web of Geometric Spider

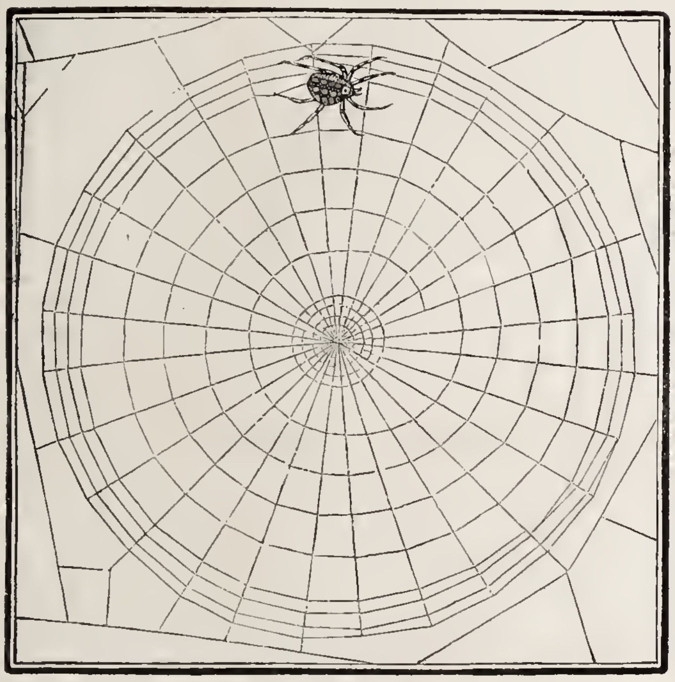


3313.—Garden Spider.

3316.—From Madame Merian.



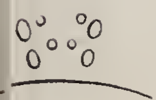
3292.



3315.—Geometric Spider and Web.

3301.

3302.

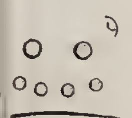


3293.

3294.

3303.

3304.



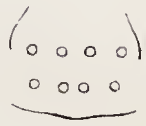
3295.

3296.

3305.

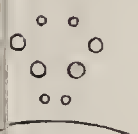
3306.

3312.—Spider's Thread.

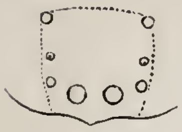


3307.

3308.

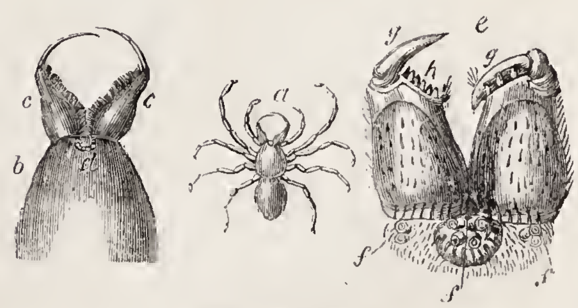


3297.

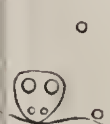


3298.

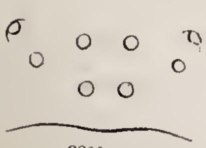
3309.—Foot of Spider.



3290.—Red Spider.

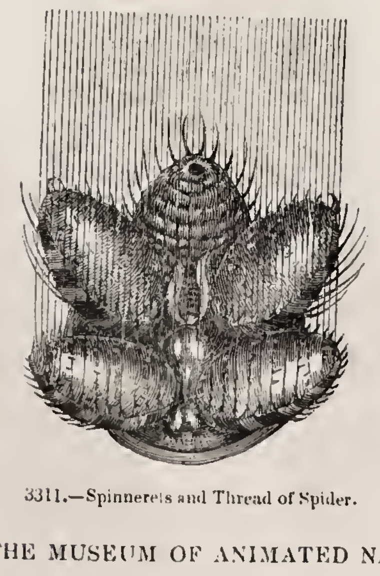


3299.

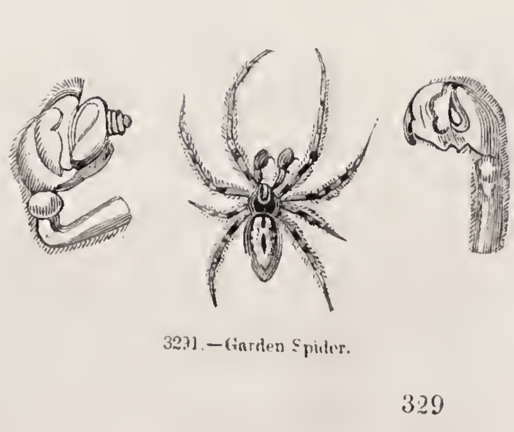


3300.

3310.—Spinnerets of Spider.



3311.—Spinnerets and Thread of Spider.



3291.—Garden Spider.

the limbs being visible. They endure with difficulty the heat of the sun, and when stranded often bury themselves for shelter. Their food consists of animal substances. Some are of very large size, occasionally measuring upwards of two feet in length. The savages of the Moluccas are in the habit of employing the caudal spike as a weapon, and a dreadful weapon it makes when fixed upon a shaft. In China the eggs are esteemed a delicacy.

Fig. 3288 represents the Limulus Moluccanus (L. Polyphemus, Fabr.): *a*, the two simple eyes; *b b*, the lateral eyes of composite structure; *c*, orifices of respiration along the abdominal buckler. It is an inhabitant of the Indian seas, and must not be confounded with the Limulus Polyphemus, Ranz., which is a native of the Atlantic along the coasts of America and the Antilles. This latter is the P. Americanus of Leach. There are other species, of which one is the Limulus rotundicauda, Fig. 3289, from the Moluccas: A, the animal seen from below; *a*, frontal portion of the carapace or buckler; *b*, anterior feet; *c*, second pair of feet; *d*, sixth pair of feet; *e*, abdomen; *f*, opercular plate formed by the two first false feet; *g*, branchial appendages; *h*, caudal spike: B, one of the second pairs of thoracic jaw-limbs: C, one of the second pair of thoracic limbs in the male of P. Moluccanus: D, one of the branchiferous false feet; *a*, the branchial appendage: E, the opercular plate seen on its internal surface, showing the orifices of the egg tubes.

Fossil specimens of extinct Limuli, some of great size, occur in certain strata, as the iron-stone of the coal formation, Colebrook Dale; the lithographic slate of Solenhofen and Pappenheim, the muschelkalk, &c.

CLASS ARACHNIDA.—(SPIDERS AND SCORPIONS.)

It has been the practice of many naturalists to place the Arachnida within the pale of the Insecta, or Insects; nevertheless, they present such important differences, both as respects external form, structure, and habits as to justify their separation into a distinct class.

In the first place, the Arachnida are utterly destitute of wings; and though many insects are apterous, yet apterous insects must be regarded as exceptions referable to other orders, in which wings are general characteristics. In the second place, they undergo no true transformations; they have no larva or caterpillar condition, but only experience a succession of moults, said by M. Jurine, fils, to be six in number before attaining to their mature state.

Another important point is, that the head is not separated, as in insects, from the thorax, but, as in the higher crustacea, coalesces with it, there being only two great divisions of the body externally recognisable instead of three.

The eyes moreover are simple, and variable in number, and the place of the antennæ is taken either by two jointed pincers or claws, which have erroneously been deemed identical with the mandibles of Insects, or, as in spiders, by two pointed hooks or fangs, for seizing and piercing prey. These claws and fangs are called antenne-pinces, or antennæ-pincers, serres frontales, and chelicières; and in spiders, mandibles, by various authors.

The limbs are usually eight in number, that is, four on each side. In some species, however, the number is six, and in others ten.

Considered with respect to the nervous system, the Arachnida differ from insects in the concentration of the ganglionic centres; this concentration being carried in the former to a higher degree, for if the scorpions be excepted (which, in consequence of the joints forming the abdomen, or tail, have an extra number of ganglia), the ganglia of the double nervous chord is at most three, and even in the scorpions it does not exceed seven.

As respects the senses, the powers of vision are acute; and though we know not where the organ of hearing is situated, we are assured that those arachnida which from their size we can most easily observe, are endowed with this faculty; no doubt the sense of taste is enjoyed in considerable perfection; most are carnivorous and duly organised for a life of rapine. Many species are parasitic, and of minute size. While lately examining through a lens the proboscis of a house-fly, we observed a mite on the terminal sucking lips, bearing the same relative proportions to the proboscis as the fly itself would to the trunk of the elephant. These parasitic Arachnida are suctorial.

The Arachnida are divided into two great orders or sections, according to the nature of their respiratory apparatus, viz.:—Pulmonaria and Trachearia. In Pulmonaria there are pulmonary sacs, in which are branchiæ for aerial respiration, performing the office of lungs, and termed by Latreille Pneumobranchiæ, or lung-gills. The heart is distinct. The eyes from six to eight. The Trachearia differ in having the respiratory organs in the form of airpipes, or tracheæ, like insects, ramifying through the system, with two external orifices or stigmata; there is no distinct heart; the eyes are from two to four. In this order Latreille places the Pychnogonids, which will be found among the Entomostracous Crustacea: they have no tracheal stigmata. Setting these aside, the Arachnida will arrange themselves as follows:—

Pulmonaria	Araneidæ, or Spiders. Phrynidæ, Phrynus, &c. Scorpionidæ, Scorpions.
Trachearea	Pseudoscorpionidæ, Galeodes, &c. Phalangidæ, Shepherd Spiders, Acaridæ, Mites, &c.

Spiders are divided into numerous genera, and indeed differ from each other materially in habits and modes of life, in the arrangement of their webs, and in their manner of capturing their insect prey. All are venomous, at least to insects, and all display ferocity, cunning, and address. Though not tolerated as welcome guests in our rooms, these animals are by no means really uninteresting;—they are at great pains to keep their downy limbs clean, passing them through their mandibles to free them from dust; they are assiduous in repairing their broken webs; they are patient in watching for their prey, and daring and skilful in the attack, and they glide along their filmy cordage with inimitable dexterity. The females exceed the males in magnitude.

By way of commencing our observations on these well-known creatures, we may first direct our attention to the mandibles or 'serres frontales.' They consist each of a stout basal joint, surmounted by a moveable, sharp, hook-like weapon, capable of being folded down or raised up; this hook or tooth is perforated by a tube leading to a poison-sac, whence exudes a deadly fluid, fatal to flies and the ordinary prey upon which the spiders feed; this fluid is thrown into the wound in the same manner as in the case of venomous snakes. The part of the basal joint against which they are folded is either furnished with a brush of hair, or distinct serrations, at least generally. Let us refer to Fig. 3290, in which *a* represents the Red Spider (Dysdera erythrina), *b*, is the head of this species magnified; *c*, the mandibles, or 'serres frontales,' with a brush of hairs against which the moveable fangs are folded; *d*, the eyes; *e*, represents the head of the Garden, or Geometric spider (Epeira Diadema), a very common but a very beautiful species, from its enamelled markings; *g g*, the fangs; *h*, the serrated or comb-like edge of the basal joint; *f f f*, the eyes.

Externally to these mandibles are the maxillary palpi, one on each side (see *a*, Fig. 3290), terminating in the female in a simple point or hook; but in the males, of some species at least, if not all, they are much more complex, and are capable of being folded up. Fig. 3291 represents the male Garden spider, with the palpi magnified. The eyes are bright and distinct, and placed on the anterior part of the cephalo-thorax. They are six or eight in number, and arranged in a different manner in different genera. By consulting the figures a better idea of their position will be formed than can be expressed by words. Fig. 3292, Eyes of Mygale avicularia: Fig. 3293, Mygale cæmentaria: Fig. 3294, Lycosa vorax: Fig. 3295, Dolomedes marginatus: Fig. 3296, Ctenus dubius: Fig. 3297, Sphasus Indianus: Fig. 3298, Attus parus: Fig. 3299, Eresus cinnabarinus: Fig. 3300, Thomisus citreus: Fig. 3301, Clubiona accentuata: Fig. 3302, Dysdera erythrina: Fig. 3303, Segestria perfida: Fig. 3304, Tegenaria domestica: Fig. 3305, Epeira Diadema: Fig. 3306, Thoridion coronatum: Fig. 3307, Latrodecta 13-guttata: Fig. 3308, Argyroneta aquatica.

The limbs, four on each side, consist of seven joints, two for the hips, one for the thigh, two for the tibia, and two for the tarsus. The last tarsal joint usually terminates in two hooks or claws with comb-like dentations, and a straighter claw with a saw-like edge. (Fig. 3309.) By means of this structure the spider is able to glide along her lines, to lay hold of her cordage, and shake her web, as may be often witnessed, probably to try its security, and after ascending a line by which she has dropped down from some elevation, to coil it up into a ball and throw it away. By means of this apparatus she also cleans her own person, and brushes away the dust from her network.

Spiders have been celebrated in every age for their webs, or filmy tissues, in which they entangle their prey, or conceal themselves or their progeny from observation. These webs are composed of threads, the production of a curious apparatus, situated under the abdomen, and called the spinneret. These spinnerets are four, or more, mammillary processes, perforated by innumerable minute orifices, through which are drawn thousands of separate lines of a glutinous fluid, the product of certain vessels, or secreting reservoirs, destined to furnish the material: the lines quickly harden, and at a little distance from the spinneret become united together, and form a single chord composed of many thousand parallel lines of inconceivable fineness. Fig. 3310 represents the spinnerets of a spider magnified, to show the apertures, or spinnerules. Fig. 3311, the mode in which the threads are drawn out, but each line represented contains about a hundred of wonderful delicacy. Fig. 3312 shows the way in which the lines all become united to form a single cord. Fig. 3313 shows the Garden spider, Epeira Diadema, hanging by a thread.

Of such delicate cordage then is the thread of the spider constructed, and such the apparatus from which

> —— "illa remittit
> Stamen, et antiquas exercet aranea telas."—Ovid.

Different as are the webs of spiders in their arrangement, it is by means of the claws that the fibres are disposed in due order, and in this labour the pectinated claws are most in requisition, the serrated claw being used in rolling up waste threads, to be rejected after the temporary purpose is served.

The webs of spiders consist either of close tissues, composed of threads crossing each other in various directions, or open lace-work, in which the threads are more or less symmetrically arranged, constituting nets of exquisite beauty. Among the artificers which produce the former kind of manufacture may be noticed the common House spider, Aranea domestica. The webs of this spider are placed nearly horizontally in the corners of rooms, among the rafters of barns, stables, &c.: their construction is as follows:—Having chosen the site, the spider fixes the first thread, which is to form the selvage of the tissue, to one of the walls, or some convenient point, and, drawing out her thread all the time, she forthwith proceeds to the opposite point, and there fastens it. This process she repeats several times, in order, by redoubling the threads, to give due strength to the margin. She next proceeds to draw threads in all directions, crossing and recrossing them until, every interval being filled up, the web exhibits an irregular gauze-like structure stretched horizontally. It mostly happens that, in addition to this web, there is an intermelé of lines carried up from its edges, so as to form a maze of cordage, so intricately blended as to prove a snare to the rambling fly, for whose destruction they are spread. Thus is the web of the House spider arranged. But where is the grim artificer? Patiently lurking in a little hiding-place or chamber covered with a close tissue of web, in a remote corner concealed from view; but watching in her den the extent of her toils spread before her. Leading to this den are a number of threads, which, vibrating upon the entanglement of the expected victim, inform the spider of the booty within her grasp; then instantly she comes forth and pounces upon her struggling victim.

Of the net weavers the Geometric spider of our gardens, Epeira Diadema, is an example. Who that has walked abroad on a fine autumnal morning can have failed to notice the nets of radii and concentric circles fabricated by this artist! The mode in which the Geometric spider constructs her net is not a little curious: the outline is first formed and secured: then the radii; and, when a sufficient number of these are arranged, beginning at the centre, she forms the concentric circles. From these nets, which are placed vertically, lines extend to distant objects, and are carried from branch to branch. The mode of fixing these is not well understood. According to Mr. Blackwall, the spiders shoot out

these lines, availing themselves of currents of air, which carry them lengthening still, till their floating extremity becomes attached to some fixed object. Experiments made by insulating spiders on a branch or twig surrounded by water seem to prove the truth of this explanation. Generally the Geometric spider stations herself in the centre of her web,—watching for prey, but not always—for, as we have repeatedly observed, she often lurks under the shelter of an adjacent leaf, ready to glide along her cordage, like a sailor from the topmast, upon her heedless victim. Fig. 3314 represents the webs of the geometric spider. Fig. 3315 shows one of these spiders in the act of constructing its web.

All have heard of the gossamer spiders (Aranea obtextrix, and Tetragnatha extensa), which mount high into the air on filmy threads sailing above spires and trees, and anon descending to the ground.

The appearance of gossamer in the air and on the ground is generally in autumn; and at this season vast showers have been seen to fall carpeting fields, hedges, and stubble lands. Lister saw a shower in Cambridgeshire in the month of October, and Gilbert White saw a similar phenomenon in September.

The mode in which these spiders rise is by shooting out their webs, upon which they are borne aloft, and that, too, when not a breath of air is stirring. They appear to depart as if by magic; nor is the explanation of the fact easy. We have ourselves watched these spiders throw out a line or streamer, exquisitely fine, and mount rapidly, disappearing in an instant. Many observers, and among them Mr. John Murray (Loudon's 'Mag. Nat. Hist.'), consider the phenomena to be electrical. This writer states that the aëronautic spider can propel its threads both horizontally and vertically, and at all relative angles, both in motionless air or in an atmosphere agitated by winds; nay, it can dart its thread against the current, or, as the sailor would say, in the wind's eye, which he contends depends on some electric action. On the contrary, Mr. Blackwall denies that spiders have the power of darting out their thread in motionless air, and attributes the extension of the lines entirely to atmospheric currents; but we ourselves have watched the spiders take flight in sultry weather, when there has not been the slightest perceptible movement of the air, and indeed we have thought them at such times the most active. We have caught them, and watched them elevate the abdomen and in an instant sweep away from our hand. Mr. Bowman observed aëronautic spiders sailing on a parachute formed by two diverging fasciculi of threads, and he informs us that in this aërial navigation the adventurer floats with its back downwards and its legs folded, thus reposing on its streamer. It is probably in quest of minute insects found only at some elevation that these spiders take to flight.

The Rev. G. White, the Rev. Mr. Kirby, and others, are at a loss to account for the showers of filmy flakes which spread over the ground, and for the reason why the film loses its buoyancy and descends. But the explanation does not appear difficult, much less so, at least, than that of the ascent of the film. Suppose a number of spiders to rise each on a filmy streamer, and having attained a certain elevation, to continue to give out threads in greater abundance, it would soon happen that the streamers of assembled multitudes would become intertangled so as to form flakes, which from a slight electric change in the state of the atmosphere might, though no clouds were visible, become saturated with moisture, and thus rendered of greater specific gravity than the air; they would then lightly descend, the spiders quitting them. But, even without being saturated with moisture, such flakes as we have ourselves often seen, and which were formed either purposely by the spiders, or accidentally by the intertanglement of many streamers together, would, when the upward atmospheric current, caused by the rarefaction of the heated stratum of air adjacent to the ground, and by which they were carried on high, ceased towards the evening, they would gradually fall and spread over the dewy grass, becoming completely saturated; and indeed we deny not that to this rarefaction and upward current of the air, rather than to any electric causes, the midday ascent of these spiders in sultry breezeless weather, as we have seen, may be attributed.

All spiders do not weave webs to entangle their prey; some hunt cat-like for their victims, on which when within due distance they spring side-ways with unerring aim; the zebra-marked Salticus scenicus adopts this plan. Some chase their prey; some lie in ambush for it, concealing themselves in rolled up leaves, in holes in walls, in crevices in bark, and some, with deeper craft, in the calyx of a flower. Many of the hunting spiders, as the huge Mygale of South America; the Thomisus venatorius of the West Indies; the Cteniza or Mygale cæmentaria, and the Lycosa Tarantula, construct singular nests or dwellings in the ground, to which, as the lion to his lair, they return with their victims.

It was respecting that hunting spider, the Mygale, which weaves no web, that Madame Merian concocted her fabulous account, relative to its capture of humming-birds, and Fig. 3316, from her illustration, depicts the poor bird in the clutches of its foe. We refer for some observations on this point to vol. I. p. 378, lower part of the first column et seq. Some spiders, as the Lycosa piratica, skim over the surface of the water in pursuit of prey, and the Argyroneta aquatica and other congeners dive under water and there seize their food, their bodies being kept unwet by an atmosphere of air surrounding them. There too beneath the water do they reside in a filmy dwelling, or air-filled diving-bell, attached by threads to plants; this they close up, rendering it like a cocoon, and in it pass the winter season, in a state of hybernation. We have already alluded to the genus Mygale, which as we have said makes singular domiciles in the earth. One species in the West Indies digs a hole of about three inches in depth, and lines it with a tough thick leathery web, of a rufous colour, with a firm lid capable of being opened or shut at pleasure; another species from the same place composes a similar nest of clay, lining it with a silken tapestry, of a texture like that of very fine glove-leather, with a circular door, the size of a crown piece, formed of several layers of similar compact tissue, having an elastic hinge, and fitting the aperture so accurately that the joining is with difficulty detected.

An allied species, found in Southern Europe (Mygale cæmentaria), forms a somewhat similar structure. She selects as the site of her nest a place destitute of grass, and having such a slope as to give quick drainage to the water. Here, in the firm dry soil, she digs a pit to the depth of one or even two feet, and of equal diameter throughout. This she lines with a tissue of close silken threads, and forms a deep conical nest or dwelling, of a thick and warm fabric. The entrance is closed with a circular valve or lid, composed of several layers of earth, intermingled and bound firm with silk, and capable of being opened or shut at pleasure, turning on a silken hinge. So accurately does this lid fit the rim of the nest, that it might seem to have been fashioned by the hand of a human artificer. Fig. 3317 shows this species and its nests: A, the nest shut; B, the nest open; C, the spider; D, the eyes magnified; E, F, parts of the foot and claws magnified.

Fig. 3318 represents the long-legged House-Spider (Pholcus phalangioïdes) often seen rapidly running along the walls of our rooms in autumn. It spins a very loose irregular web, and pursues gnats and other flies with great eagerness.

Spiders envelop their eggs in a cocoon of silk; these are attached often by long threads to stems, palings, or spikes of grass, as seen at Fig. 3319, where three different examples are given.

Towards the latter part of summer clusters of the eggs of the Epeira diadema may be observed in great abundance on bushes, hedges, &c. When hatched, the young all keep together, and appear huddled up into a ball, from which very fine lines may be observed to diverge over the adjacent leaves, forming a delicate maze. It is amusing to see the living bubble burst when touched, and the alarmed multitude scatter in every direction; nor is it uninteresting to see them reassemble, and huddle together as before. Fig. 3320 represents the progress of the egg of the garden spider: *a*, the egg, natural size; B, the egg magnified, showing the white cicatricula in the centre: C, the egg with the germ enlarged; *a*, the head; *b*, the body of the enclosed young: *d*, the young spider (magnified) ready to moult its first skin.

Some spiders, as the Lycosa saccata, carry their sac or cocoon of eggs with them wherever they travel. The species named, one of the hunting tribe, holds this cocoon between her hind legs, and manifests the greatest anxiety in its preservation. The young when hatched cluster over her body. Another species, the Clotho Durandii, Latreille (Uroctea quinque-maculata, Duf.), found in Egypt and Dalmatia, and also in the mountains of Narbonne, the Pyrenees, and the rocks of Catalonia, weaves in the fissures of stones or crags a tent of admirable workmanship in which to rear her young.

Spiders, the destroyers of insects, themselves fall a prey to insects in their turn. Among their enemies is a species of Ichneumon-fly, Sphex, called in Savannah black and yellow masons, besides other species. These insects make oblong cases of clay, which they plaster in layers to roofs, ceilings, or other convenient places. When a case is finished, they lay an egg inside at the end, and then fill it with spiders and plaster it up. The larva by the time it eats them all is mature, and spins a thin shroud, changing into a chrysalis. It would appear that the spiders are paralyzed by these Ichneumon-flies, probably by means of the sting; at all events they are only just capable of moving, but remain plump and fresh. Very rare spiders are often found in these prisons, and some which are never seen elsewhere, and which live, it is to be supposed, on the topmost branches of the highest trees. The number of spiders which thus fall victims is extremely great. But we must not linger on spiders; the formidable scorpion demands a short notice.

The sight of a large scorpion advancing with his many-jointed tail elevated, and ready to inflict a venomous wound, will give us some idea of the force of that expression, "a lash of scorpions," the fulness of which can only be felt in a country where these dreaded creatures abound. In their appearance, as well as in their disposition, these animals have much to disgust the ordinary observer, and it must be owned that they are formidably armed. The maxillæ, which in insects are small, are here developed into enormous crab-like claws, capable of seizing with great power, and of crushing their prey. Besides these, we find the mandibles forming on each side of the mouth a smaller but similar claw, for the purpose of holding the food which they are in the act of eating. The tail terminates in a sharp curved sting, which, analogous to the poison-fang of a serpent, instils venom into the wound it makes.

The body of the scorpion is composed of a broad cephalo-thorax, covered with a single plate, and succeeded by an abdominal portion of seven rings overlapping each other. To this succeeds a caudal prolongation of six joints. Scorpions have six or eight eyes, two on each side of a dorsal furrow, on the middle of the cephalo-thorax, and two or three at each anterior angle of the latter.

Scorpions tenant the hotter regions of both hemispheres, concealing themselves under stones, among crumbling ruins, in obscure corners of houses, and the like. They run very actively, arching the tail over the back, and in attacking their prey seize it with their claws, and instantly pierce it with the sting. They spare not even their own species. Maupertuis put a hundred scorpions together, and a murderous conflict immediately ensued; almost all were massacred in a few days and devoured by the survivors.

The sting of the common scorpion of Southern Europe and Barbary (Buthus occitanus, Leach), or the six-eyed European species (Scorpio Europæus), is not fatal except to small animals and insects. But in the hotter regions there is some degree of danger. In South America the sting of some kinds has been found to occasion fever, numbness of the limbs, and dimness of sight, lasting for two or three days, and death is said to result sometimes from the wound of the black scorpion of Ceylon. Mr. Kirby states that the only means of saving the lives of our soldiers who were stung by these creatures in Egypt was amputation.

The scorpion produces its young alive, and they do not arrive at maturity till after the lapse of two years. During the first days of their existence they are carried by the female on her back. She then keeps close in her retreat, and assiduously guards them. In about a month they are capable of shifting for themselves.

Fig. 3321 represents the African scorpion (Scorpio Afer, Linn.; Buthus Afer, Leach). The scorpion is among the animals represented on the sculptured remains of Ancient Egypt.

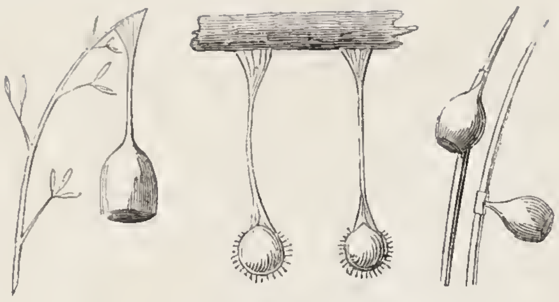
Turning to the Trachearea, we may first notice those minute creatures, the mites (Acaridæ), many of which are parasitic, and known as ticks (Ixodes); they infest animals of various kinds, and even insects; we often see the common dor-beetle covered with these pests. Some species live in cheese, some on leaves, or beneath the bark of trees, and some, as the Hydrachna, are aquatic.

In the genus Acarus the palpi are short, or concealed and forked; the body is soft, and the feet have at their extremity a vesicular cushion. Fig. 3322 represents the domestic mite (Acarus domesticus) very common in collections of insects and cabinets of stuffed birds, to which it proves extremely destructive, nor will camphor altogether prevent its incursions.

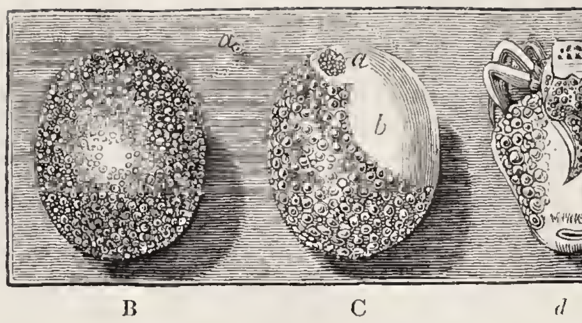
Fig. 3323 represents, highly magnified, the Acarus Scabiei, found in the pustules of a well-known cutaneous disease, "la gale humaine" of the French, and for which sulphur is a remedy. Bruelli and Dr. Galet have detected this animal in the skin, and have observed it multiply; and their inference is that if it does not produce it accompanies the disorder. Indeed Dr. Galet ascertained that these mites transferred to the skin of a healthy person communicate the disease.

Fig. 3324 represents the Sparrow mite (Acarus passerinus), or Bat-tick of Geoffrey. It is parasitic, and remarkable for the size of the third pair of limbs.

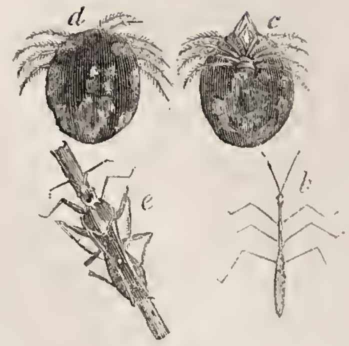
Fig. 3325 the Harvest-Bug, greatly magnified. This species, "Le Rouget" of the French (Leptus autumnalis), abounds during summer and autumn on the grass of the meadows, and the brushwood of



3319.—Spiders' Nests.

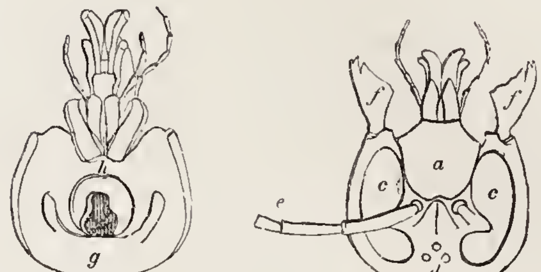


3320.—Eggs of Garden-Spider.

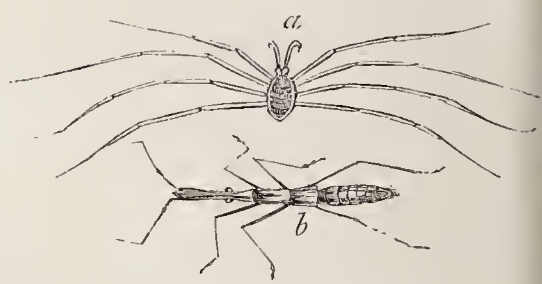


3326.—Water-Mites.

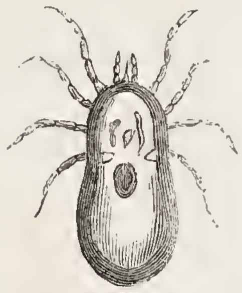
3318.—Long legged House-Spider.



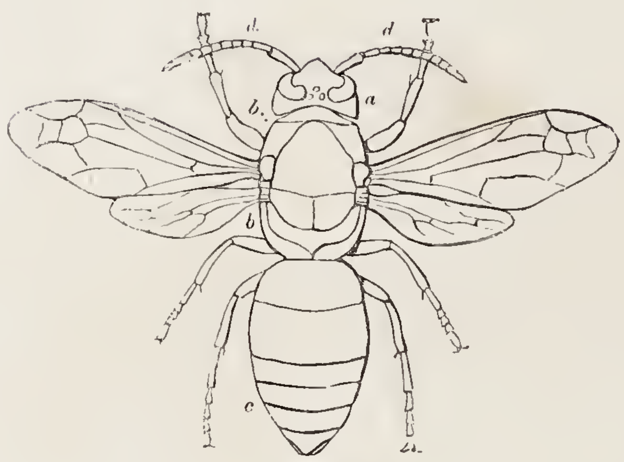
3331. Head of Hornet. 3330



3328.—Shepherd Spider.



3324.—Sparrow-Mite.

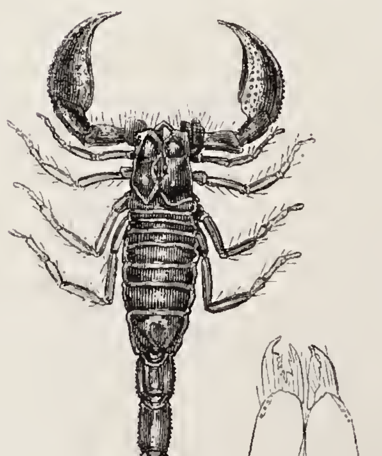


3329.—Hornet.

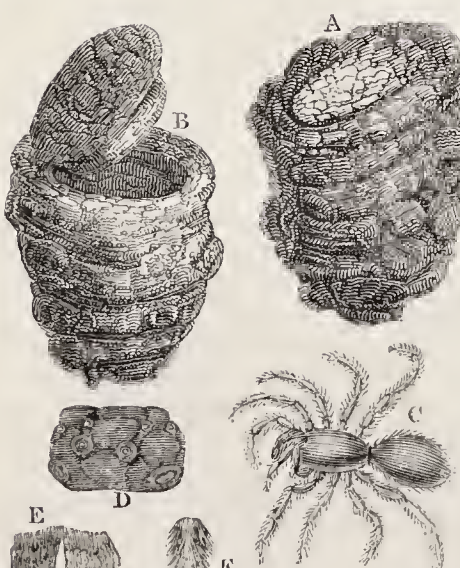
3325.—Harvest Bug.

3322.—Domestic Mite.

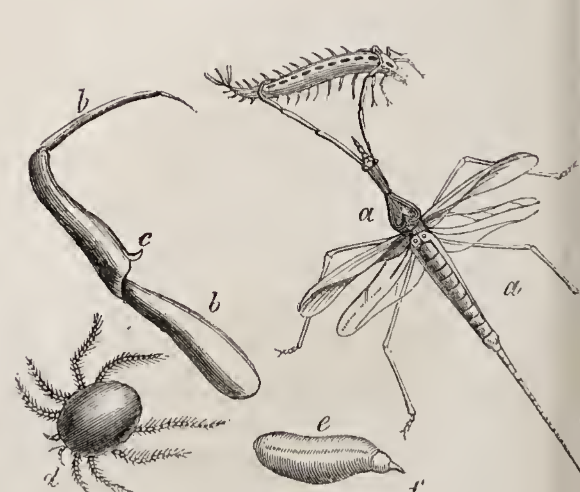
3323.—Acarus Scabiei.



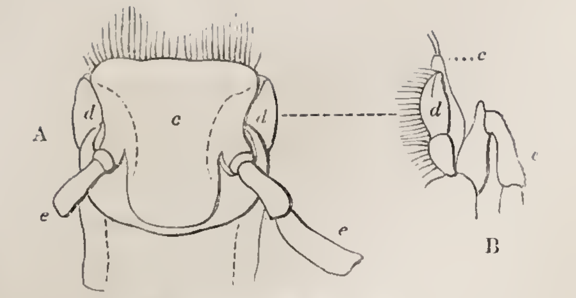
3321.—African Scorpion.



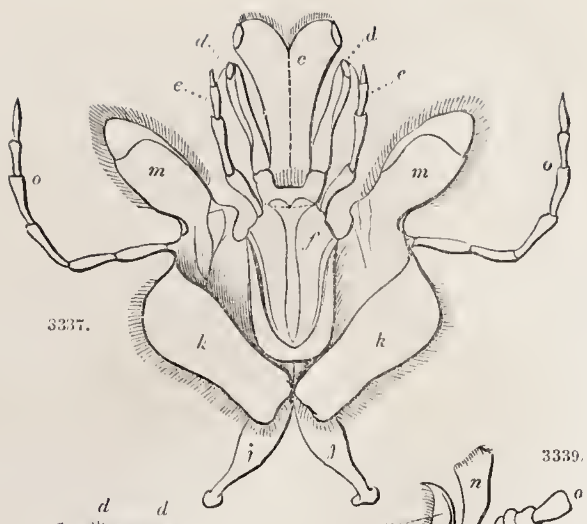
3317.—Nests, &c. of Mason-Spider.

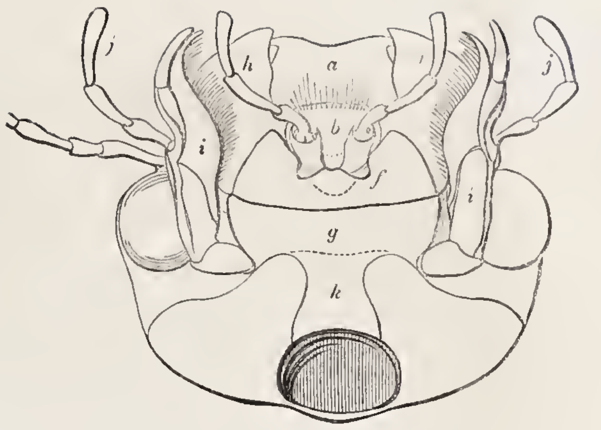


3327.—Water-Mites.



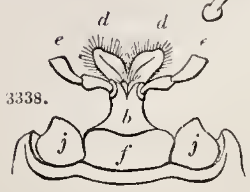
3334.—Palpiger of Water-Beetle.

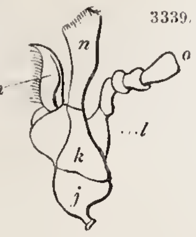


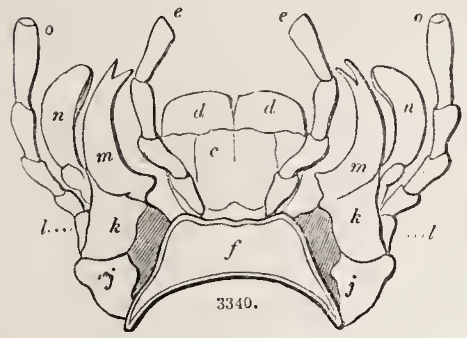


3333.—Mouth of Water-Beetle.

3335.—Mouth of Amphimalla solstitialis.

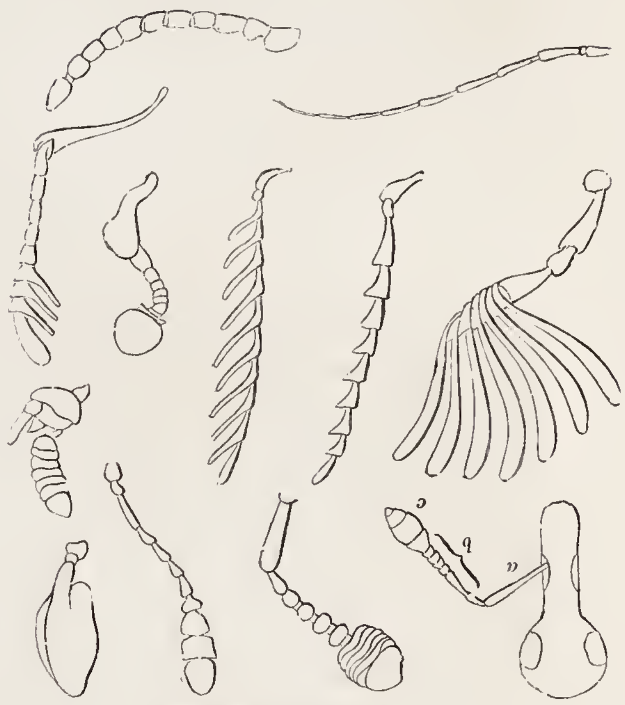




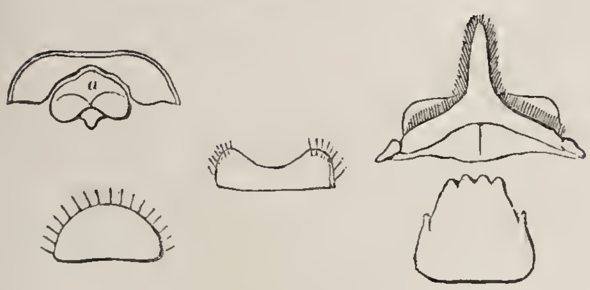


3337 to 3341.—Parts of Mouth of various Insects.

3345—Maxillæ of various Insects.



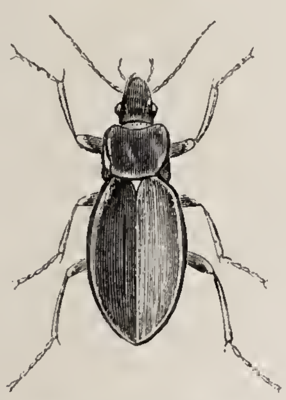
3347.—Antennæ of various Insects.



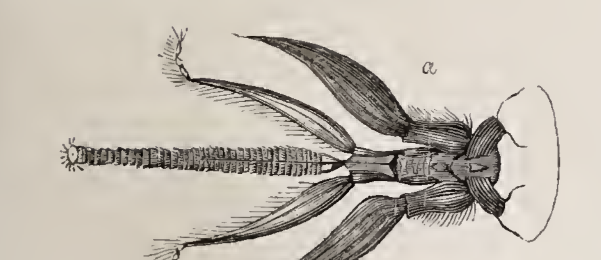
3326.—Labrum of various Insects.

3332.—Stag Beetle.

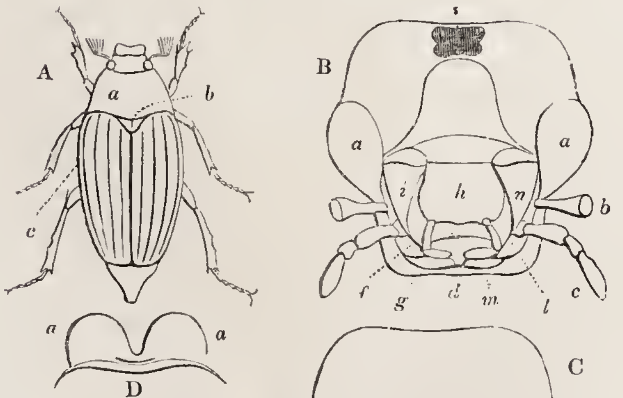
3346.—Predaceous Beetle.



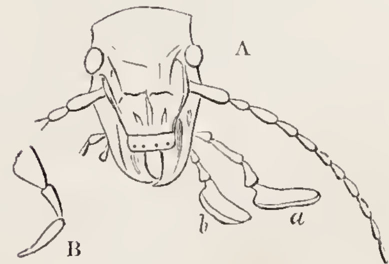
3343.—Carnivorous Beetle.



3349.—Mouth of Bee.



3342.—Parts of Head of Beetle.



3344.—Details of Carnivorous Beetle.

3348.—Tongue of Bee.

copses, and is, during the time of harvest, a pest to those who walk in the fields, or among the fragrant hay. It insinuates itself into the skin, and occasions, as Latreille says, "des démangeaisons aussi insupportables que celles produites par la gale." It appears to be capricious in its taste, attacking some persons in preference to others.

The Water-mites (Hydrachna) are aquatic, and very common in ponds and ditches, where they walk through the water, and also at the bottom, often in company with a bright scarlet species (Limnosehares holosericea, Latr.), which must be distinguished from the Scarlet Satin mite (Trombidium holosericeum), so common on dry banks, or on palings, &c., in the spring.

The Water-mites deposit their eggs upon the bodies of water-scorpions (Nepa), and as they increase in size Rösel is inclined to think that they derive their means of growth from the body of the insect to which they are attached: and De Geer remarked that the Nepæ, when most infested with these eggs, which are red, became gradually weakened as the latter augmented in size.

At Fig. 3326, the Hydrachna geographica, Latr., is seen in a front and back view, magnified. Of the two under figures, *b* is the Water Measurer, Hydrometra stagnorum; *e*, Velia currens, both hemipterous aquatic insects, and very common, especially the former.

Fig. 3327 represents the water-mite (Hydrachna abstergens) and the Nepa cinerea, on which she fixes her eggs: *a a*, the nepa or water-scorpion in the act of seizing prey; *b b*, a magnified view of the claws of this insect; *c*, a tooth-like process for restraining the motion of the joint: *d*, the water-mite; *e*, a magnified view of one of its eggs; *f*, the pointed hook by which it is inserted into the body of the Nepa.

Another group under the Trachearea consists of the Shepherd-spiders, or Harvest-men and their allies (Phalangidæ).

The Common Shepherd-spider (Phalangium cornutum and Opilio, Linn., male and female) so remarkable for its long slender legs, is known to all. It abounds at the latter part of summer, and may be seen reposing with the limbs spread out on walls, or other places of security; it appears indifferent to the loss of these long thin legs, which break off upon the slightest touch, and retain their irritability for several seconds. Fig. 3328 represents the common shepherd-spider: *a*, with its long limbs formed for rapid locomotion among grass, in contrast with the aquatic water measurer, Hydrometra stagnorum, *b*.

CLASS INSECTA.—(INSECTS.)

INSECTA or true Insects are animals of the Homogangliate or articulate sub-kingdom, having the body divided into three portions, whence the title Insecta (animals cut into), and in Greek Entoma. To this character it may be added that they are covered in general with a coriaceous or horny integument serving as an external skeleton. They possess when mature three pairs of legs. They are capable for the most part of flight, having two or four wings; they undergo three transformations from the egg to maturity. These characters may not be all or always evident, yet in no instance are they decidedly and truly absent. Departures in degree from a given type, and modifications in the details of structure, are met with in every class, yet the essentials, upon which the claim of the species to any given class is founded, remain inviolate. The structure of the bat for flight, and of the whale for oceanic habits, does not remove these animals from among the mammalia.

It has been said by a great Entomologist, that insects are nature's favourite productions, in which to manifest her power and skill she has combined all that is either beautiful and graceful, interesting and alluring, or curious and singular, in every other class of her children. To these her valued miniatures she has given the most delicate touch and highest finish of her pencil. Nor has Nature been lavish only in the apparent ornaments of these privileged tribes. In other respects she has been equally unsparing of her favours. To some she has given horns nearly the counterparts of those of various quadrupeds; some are covered with bristles; others with spines; some are of richest hues, sparkling like gems, topaz, sapphire, and amethyst in the rays of the sun; some gleam in polished armour—

> "Like some stern warrior formidably bright
> Their steely sides reflect a gleaming light;"

others are dull of colour, and of strange form and aspect, resembling withered leaves or bits of stick, and find security in such resemblances.

To leap, to run, to walk, to bore into the ground, or drive galleries through timber, to fly through the air, to gambol in the water, and dive and swim, are amongst the endowments of insects—some build structures more wonderful than the pyramids, some gleam with phosphorescent radiance—and many are armed with poisoned weapons. They furnish us with silk, wax, honey, lac, cochineal, and gall-nuts. Some hold an important place in the pharmacopæia, some are eaten by various tribes of man, and multitudes furnish food to the beasts of the earth, the birds of the air; to the reptile tribes; to the fishes; and to the more powerful of their own class.

To proceed, however, more closely with our subject. If we place an insect, say the Hornet, Fig. 3329, before us, we shall observe, that it is divided as we have said into three distinct regions, the head, (Caput) the thorax, and the abdomen. The head carries the organs of the mouth, the eyes, and the antennæ, and encloses the principal nervous ganglion.

Referring to Fig. 3329—*a* is the head; *b*, the thorax; *c*, the abdomen; *d d*, the antennæ. The eyes are two, and compound, but besides these there are minute simple eyes, called stemmata. The parts of the head, excluding the eyes and antennæ, are respectively termed the clypeus or nasus, the vertex, the occiput, the genæ or cheeks, the canthus, the gula; and the seven portions forming the mouth, called Trophi.

Fig. 3330 shows the head of the Hornet magnified—*a*, the clypeus; *b*, the vertex; *c c*, the compound eyes; *d*, the stemmata; *e*, one of the antennæ; *f*, the mandible. Fig. 3331, the same viewed from beneath; *g*, the occiput; *h*, the gula.

In turning our attention to the mouths of insects we must premise by stating that, from the difference existing in the form and uses of the parts composing it, it is either mandibulate, that is, formed for biting, or haustellate, formed for suction. It is to the mandibulate mouth that our description will apply.

The seven portions termed Trophi, consist of a labrum or upper lip, a labium or under lip, two mandibles or jaws, two maxillæ or under jaws, and a tongue. To the maxillæ or under jaws are attached a pair of feelers called maxillary palpi; and a similar pair is also attached to the labium or under lip; these are the labial palpi. Each of these parts enumerated requires further notice. The labrum is usually moveable and articulated to the clypeus, terminating the head anteriorly; it is opposed to the labium, and their joint use appears to be to keep the food in its proper place, while the jaws are at work upon it. The labium is divided into three portions; the palpiger, the mentum, and stipes. The labial palpi usually consists of two articulations, exclusive of their basal attachment; they serve as feelers of the food. The mandibulæ and maxillæ act horizontally between the labrum and labium.

The mandibulæ are used for seizing and biting; when viewed from above or beneath they generally present a figure more or less approaching to a triangle, but are externally convex, internally concave, the concave surface being furnished with serrations or tooth-like processes. As insects with the mandibulæ or jaws formed on the principle described vary in their food, so, as in Mammalia, do these upper or rather anterior jaws vary in their details. In the Cerambicidæ which gnaw vegetable food there is something in the form of the upper jaws analogous to the incisor teeth of Rodents. In Carnivorous insects, as Cicindela, Carabus, Staphylinus &c., they remind us of the formidable canines of the tiger, and are often armed with sharp serrations, or spear-like points. In some, which feed on hard vegetable matter, the upper jaws are stout, short and strong, and have a lobe at or near their base, and a broad crushing or grinding surface; and remind us of the molar teeth of mammalia of the Ruminant or pachydermatous orders. In some insects which feed on soft animals, as worms, the mandibles though sharp have no serrations, and this sort of jaw is sometimes tubular, with a minute orifice near the apex; in this case the insect sucks the juices of its prey through the tube.

A singular modification is seen in the jaws of the stag beetle, Lucanus Cervus, Fig. 3332; they are greatly enlarged and antler-like, and in the opinion of Mr. Waterhouse are used for piercing and lacerating leaves and twigs, thus causing a flow of sap, upon which the beetle feeds.

With repect to the maxillæ or under jaws, which are placed beneath the mandibles and move nearly parallel to them, we may observe that, exclusive of the maxillary palpus, each maxilla, besides its true and effective part or lobus inferior, has an appendage, sometimes rudimentary, sometimes wanting, but often composed of two or three joints, and resembling an additional palpus. The maxillæ appear to assist in turning the food about during the operation of the mandibles. The basal joint of the maxilla on which it moves, is called the Cardo or hinge.

The tongue or lingua is situated within the labium or lower lip, and sometimes emerges from it. In many cases it constitutes an organ for the collecting of food, which it transmits to the gullet; in these instances it is peculiarly modified.

For a farther explanation let us refer to our pictorial specimens. Fig. 3333 shows the parts of the mouth of a water-beetle (Dyticus marginalis): *a*, the labrum: *b*, *f*, and *g*, the labium; *b*, the palpiger; *f*, the mentum; *g*, the stipes; *h h*, the mandibulæ; *i i*, the maxillæ; *j j*, maxillary palpi; *k*, the jugulum. Fig. 3334, the palpiger highly magnified: A, the front view; B, the side view; *c*, the lingua; *d d*, appendages termed paraglossæ; *e*, the labial palpi. Fig. 3335 the parts of the mouth of Amphimalla solstitialis; the letters correspond with those on the preceding.

Fig. 3336 represents the various form presented by the labrum in insects; that of the central delineation is the most common.

Fig. 3337 represents the labium and maxillæ of the Hornet. Fig. 3338 the labium of Cerambyx moschatus. Fig. 3339, the maxilla of the same insect. Fig. 3340, the labium and maxillæ of a locust. Fig. 3341, the labium of another species of locust. In these the same letters refer to the same parts; *b*, palpiger; *c*, lingua; *d*, paraglossæ; *e*, labial palpi; *f*, mentum; *j*, cardo of maxilla; *k*, stipes of maxilla; *l*, palpifer; *m*, lacinia, or upper lobe of maxilla; *n*, galea, or true maxillary portion; *o*, maxillary palpi.

Fig. 3342 represents a species of Beetle, and the parts of the head and mouth. A, Beetle: *a*, the thorax; *b*, that portion of the thorax called the scutellum; *c*, elytra or wing cases: B, the head, posterior view—*a*, the eyes; *b*, antennæ; *c*, maxillary palpi; *d*, clypeus; *h* and *g*, labium; *f*, labial palpi; *i*, *n*, *m*, *l*, maxillæ and parts: C, the same head viewed anteriorly: D, labium: E, F, mandibles of coleoptera: G, maxilla: *a*, maxillary palpus; *b*, lobus superior; *c*, true maxillary blade; *d*, cardo: H. *c*, the tongue; *b*, labial palpi; *a*, labium: I. *a*, labrum; *b*, mandibles of a carnivorous beetle: K, L, labrum.

Fig. 3343 represents a carnivorous beetle, the Carabus violaceus; and Fig. 3344—A, the head of another carnivorous species, Tefflus Megerlei magnified—*a*, maxillary palpus; *b*, labial palpus: B, maxillary palpus of Carabus violaceus.

Fig. 3345 shows the maxillæ of various insects, composed each of the cardo, or basal hinge-joint, to which succeeds the stipes or stake, and then the blade or lacinia, or lobus inferior. Besides these parts is the palpifer or base upon which the maxillary palpus is placed, as well as the lobus superior or galea.

Fig. 3346, a predaceous beetle, Leistus fulvibarbus, *a*, the trident-shape tongue highly magnified.

Fig. 3347 shows a few of the strange variations in form to which the antennæ among the beetle tribes are subject—*a*, the scapus or basal joint; the following joints, *b*, are termed funiculars; the terminal joints often form what is termed the clava, *c*.

Such then is the structure of the true mandibulate mouth, in which the organs are formed for the disposal of solid food. We may now turn to the Haustellata, in which the mouth is formed for sucking up fluids, the nectar of flowers, the juices of plants, and the blood of animals.

Now, however different the mouths of the Haustellata may be from the mouths of the Mandibulata, let it be remembered that the difference is one of modification only. The parts are the same, but their form, their modes of application, and their

relative proportions are altered, or so to speak new fashioned. But indeed before we leave the Mandibulata, we find a remarkable modification in the mouth of some insects which lap the honey of flowers, as the bee, which is not haustellate, though the term proboscis has been applied to its mouth, from an erroneous idea.

In the Bee and its allies, the mandibles are large and powerful, the labrum varies in shape, but is distinct. The maxillæ are elongated and modified into a sheath for the tongue, and are affixed to the mentum or base of the labium, with small palpi. The labium is elongated, and articulates with the tongue which is carried from it. The tongue, which in most insects is short, is long and slender. The labial palpi have four joints, the most which these organs ever have, and they are remarkable for exceeding in length the maxillary palpi, which are ordinarily the longest. The two first joints are compressed, the two last joints are small and are set on below the apex of the second joint.

Returning to the tongue, we find it sheathed at the base, with two membranous appendages, found also in predaceous beetles, and termed paraglossæ. The upper part of the tongue is cartilaginous, and remarkable for a number of transverse rings; it is moved by numerous muscles. Below the middle is a membrane longitudinally folded, when not in use, but capable of being distended to a considerable size. This membranous bag receives the honey which the tongue laps from the flowers.

Fig. 3348 exhibits the tongue of the bee—A, the head; *a a*, the tongue: B, the tongue displayed; *b b*, the tongue: *c*, the sheath of the tongue; *d*, muscles for moving the tongue: C, the tongue greatly magnified to show its annulated character.

Fig. 3349, *a*, the apparatus of the bee's mouth; the sheaths of the tongue being opened, and the tongue stretched out; *b*, the under side of the apparatus, the tongue lodged in the sheath; *c*, the under side of the tongue, the maxillary sheath opened.

Fig. 3350 represents the tongue of the hive-bee. *c*, the tongue, at its base are the paraglossæ, and externally to these the labial palpi. These are all based upon the labium; then follows the mentum, and on each side are seen the sheath-like maxillæ; *b*, the hinder leg of the worker-bee; *d*, the part on which the pollen is carried.

Fig. 3351 is the under side of the head of a bee belonging to the genus Melitta, showing the mouth. *a*, the tongue. In Apis the tongue is generally long, and the proboscis itself has two joints, one near the base, and another about the middle, that at the base directing it outwards, that in the middle directing it inwards; when folded, the apex of the tongue points backwards. In Melitta the tongue is short, and the proboscis has but one fold, which is near the base, and when folded the apex of the tongue points forwards.

The tongue of the bee is admirably adapted for clearing the honey out of the deep nectaries of flowers, such as the Larkspur (Delphinium choilanthum), Fig. 3352, A, or the Columbine (Aquilegia bicolor), B. This organ can be unfolded with the greatest rapidity, and moved about in every direction; sweeping the nectary with the utmost address; the honey, as fast as collected previously to being swallowed and consigned to the honey-bag, is deposited in the membranous sac already noticed, which soon becomes greatly distended.

With respect to the Wasp, Hornet, &c., which in many points resemble the bee, they differ from the latter in the non-development of the tongue, and in the size and strength of the mandibles.

The tongue of the bee then is not a tubular haustellate organ, but intended for lapping up honey; and having urged this distinction, let us now attend to the true haustellate mouth, as we see it displayed in many insects; and, first, the Butterfly, which, like the bee, revels among the flowers, and drains their nectar treasures. In the butterfly and moth we find a long spiral proboscis coiled up under the head, but capable of being unfolded. This proboscis is formed by the maxillæ or lower jaws. Instead of being hard pincers, these organs are fashioned into slender tubes, and together form a long tubular apparatus, like the fine tendril of a vine. Each maxilla is lengthened into a long annulated cartilaginous filament, hollowed out longitudinally, and governed by two layers of spiral muscles; the sides which oppose each other are channelled like a split reed, so that when the edges of each tubular filament are put together, and interlocked by means of a multitude of minute barbs, like those along the plumelets of a feather, they form a tube of a somewhat square shape, and placed almost intermediately. Thus then we have three tubes, of which the central leads to the gullet; and it is through this that the honey of flowers is imbibed. What then, it may be asked, is the use of the two lateral tubes? As the butterfly cannot exhaust the air in the tube, as animals breathing by means of lungs would exhaust a pipe continued from the mouth, and so suck up liquid, it would appear that the lateral tubes, by the action of the spiral fibres surrounding them, alternately compress and dilate the central compartment, which, during the dilatation, draws up the nectar, into which the end of the proboscis is dipped. These filamentous maxillæ are developed, at the expense of the other parts of the mouth, which though rudimentary may nevertheless be demonstrated. There are mandibles to be discerned, a labrum or labium, and maxillary, and labial palpi; the latter, indeed, appear on each side of the proboscis in the form of two plumose appendages.

Fig. 3353 represents the proboscis and mouth of a moth (Sphinx celereo), considerably magnified. A, profile of the head with the sucker unrolled; B, the labrum and mandibles; C, the jaw, and part of the sucker; D, labial palpi; E, portion of the sucker, showing the three tubes of which it is composed, viewed from above; F, the same part viewed from beneath.

Another form of sucker, in which the haustellum is adapted also for puncturing the bark and surface of the leaves of trees, is displayed by the Aphides, the serious ravages of which in gardens, orchards, and hop-grounds, are so well known. In the Brown Aphis of the oak (Aphis quercus) the perforating sucker is longer than the body, and when not in operation is carried between the limbs close to the body. It consists of a transparent tube, with an orifice of extreme minuteness, and within are two instruments which Réaumur supposed fulfilled the office of the piston in a pump. At Fig. 3354, *a* shows the Aphis of the natural size, with the sucker bent under it and protruding like a tail; *b*, the same magnified; *c*, the sucker magnified.

One species of Aphis (Aphis lanigera, Illiger, Eriosoma mali, Leach) is exceedingly injurious to apple-trees. This pest of the orchard has only been known in our island within the present century; Mr. Knapp says it was first observed in the West of England, in 1819, in the nursery gardens of Messrs. Millar and Sweet, near Bristol; but Salisbury states that it was brought to this country from France in the reign of Louis XIV., when a colony of refugees settled at Paddington, where it first began its depredations. Sir Joseph Banks traced its supposed first appearance to a nursery in Sloane Street, Chelsea. But be this as it may, it soon spread over the country, and in 1810 threatened the destruction of the apple-orchards of Gloucestershire. Mr. Knapp thus details its history. "In the spring of the year, a slight hoariness is observed upon the branches of certain species of our orchard fruit. As the season advances, this hoariness increases; it becomes cottony, and towards the middle or end of summer, the under sides of some of the branches are invested with a thick downy substance so long as at times to be sensibly agitated by the air; upon examining this substance we find that it conceals a multitude of small wingless creatures, which are busily employed in preying upon the limb of the tree beneath. This they are well enabled to do by means of a beak terminating in a fine bristle, which, being insinuated through the bark and the sappy part of the wood, enables the creature to extract as with a syringe the sweet vital liquor that circulates in the plant. The sapwood (alburnum) being thus wounded rises in excrescences and nodes all over the branch, and deforms it; and the limb deprived of its nutriment grows sickly; the leaves turn yellow, and the part perishes. Branch after branch is thus assailed till they all become leafless and the tree dies.

"Aphides attack the young and softer parts of plants, but this insect seems easily to wound the harder part of the bark of the apple, and by no means makes choice of the most tender parts of the branch. They give a preference to certain sorts, but not always the most rich fruits; as cider-apples and wildings are greatly infested by them, and from some unknown cause other varieties seem to be exempted from their depredations. The Wheeler's Russet and Crofton Pippin I have never observed injured by them."

This aphis is viviparous, and the long cottony matter exuding from the parents forms a cradle for the young, enveloping both them and the adult colony.

"This lanuginous vestiture," says Mr. Knapp, "seems to serve likewise as a vehicle for dispersing the animal, for though most of our species of Aphides are furnished with wings, I have never seen any individual of this American blight so provided; but the winds, wafting about small tufts of this downy matter, convey the creature with it from tree to tree through the whole orchard. In autumn, when this substance is generally long, the winds and rains of the season effectually disperse these insects, and we observe them endeavouring to secrete themselves in the crannies of any neighbouring substance. Should the Savoy cabbage be near the trees whence they have been dislodged, the cavities of the under side of its leaves are generally favourite asylums for them. Multitudes perish by these rough removals, but numbers yet remain, and we may find them in the nodes and crevices on the under sides of the branches at any period of the year, the long cottony vesture being removed; but still they are enveloped in a fine short downy clothing, to be seen by a magnifier, proceeding apparently from every suture or pore of their bodies, and protecting them in their dormant state from the moisture and frosts of our climate. This aphis in a natural state usually awakens and commences its labours very early in the month of March, and the hoariness of its body may be observed increasing daily, but if an infected branch be cut in winter and kept in a warm room, these aphides will awaken speedily, spin their cottony nests, and feed as they are accustomed to do in the genial season."

When crushed, these aphides are of a dark sanguineous red, with a slight tinge of purple, and a dye might very probably be extracted from them.

The aphis of the rose is too common and injurious not to have attracted attention; thousands are often seen clustered together on the tender stem of the flower. Another species, of a black colour, attacks the common bean.

Honey-dew, as it is called, is the produce of various aphides; it is a sweet viscid fluid which oozes through a pair of projecting tubes at the extremity of the abdomen.

Some of the aphides, as may be seen, of both sexes, are winged, the wings being four; others are wingless. The winged individuals spread abroad, and extraordinary flights of them have been observed. White of Selborne says, "On the 1st of August, about half an hour after three in the afternoon, the people of Selborne were surprised by a shower of aphides which fell in these parts. They who were walking the streets at the time found themselves covered with these insects, which settled also on the trees and gardens, and blackened all the vegetables where they alighted. These animals no doubt were then in a state of emigration and shifting their quarters, and might perhaps have come from the great hop-plantations of Kent or Sussex, the wind being that day at north. They were observed at the same time at Farnham and all along the vale at Alton."

Fig. 3355 shows the Eriosoma mali: *a*, *b*, the insects magnified; *c*, an infected apple-branch.

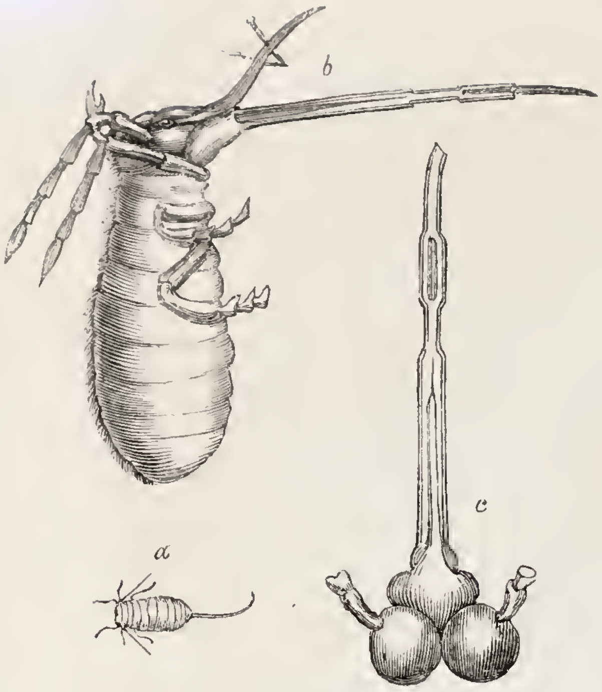
Among other suctorial insects are the Bugs, of which one species, the Cimex lectularius, which is wingless, is one of the nuisances of the bed-room. Linnæus supposes it to have been originally imported from America. The Plant-bugs are all furnished with wings and membranous wing-cases. Fig. 3356 shows the haustellum of the Cimex nigricornis. *b*, a view of the under side of the head, exhibiting the sucker in its sheath, directed backwards. The sheath is composed of four pieces, which Savigny regards as an under lip much enlarged. The edges bend downwards and form a canal for receiving four bristles which he supposes to correspond with the two mandibles, and two lower jaws. *a* shows the sheathed upper lip, and the four bristles placed together, and drawn out of their sheath; *c*, the four bristles viewed separated from each other.

Fig. 3357 represents the sucker, magnified, of a water-bug (Nepa neptunia): *a*, the sucker in its sheath; *b*, the several parts developed so as to exhibit them separately; *c*, the sucker unsheathed.

Fig. 3358, the sucker of the Flea (Pulex irritans). The sucker of the flea is complex, and adapted for drawing blood. On each side of a slender bristle-like tongue is placed a sharp razor, the blade working on a sort of handle. The sheath to these weapons represents the mandibles, the blades being the maxillæ; two long palpi are present, and there are a pair of triangular plates, perhaps labial palpi. *a*, the parts forming the sucker magnified; *b*, the same, under side; *c*, upper side.

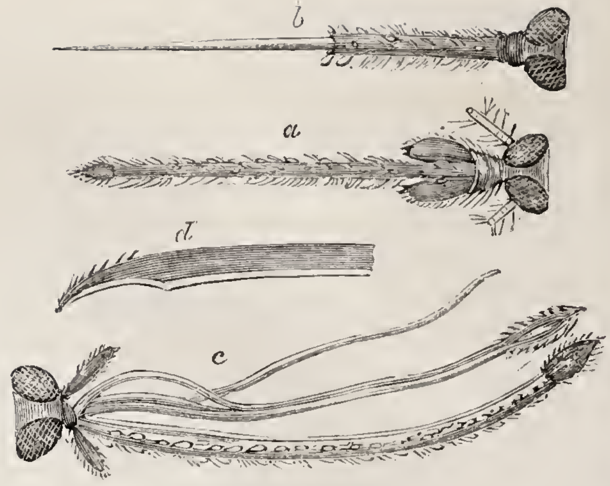
Annoying as the flea may be, it is harmless, compared to an allied species, the Chigoe of the West Indies, Pulex peletrans, Fig. 3359. This minute penetrates the skin, and almost without being felt insinuates itself generally under the nails of the toes or beneath the skin and flesh; there it enlarges to the size of a pea, causing a most disagreeable itching. In process of time, a small pustule appears, filled with multitudes of its eggs; and from this, when it breaks, are dispersed thousands of young, which in course of time create ulcerations, resulting in most calamitous, and sometimes even fatal, consequences. It is usual, when the presence of a chigoe is suspected by the attendant itching and redness, to have the parasite extracted. This is done by means of a sharp-pointed needle, and very cautiously, so as to enlarge the wound, and at the same time prevent the chigoe from being crushed in it. Walton states that a Capuchin friar, in order to study the history of the chigoe, permitted a colony to establish themselves in his feet; but before he could accomplish his object his foot mortified and had to be amputated.

Among other suctorial insects we may mention the fly, the Tabanus, the Gnat, the Mosquito, and other Culicidæ.

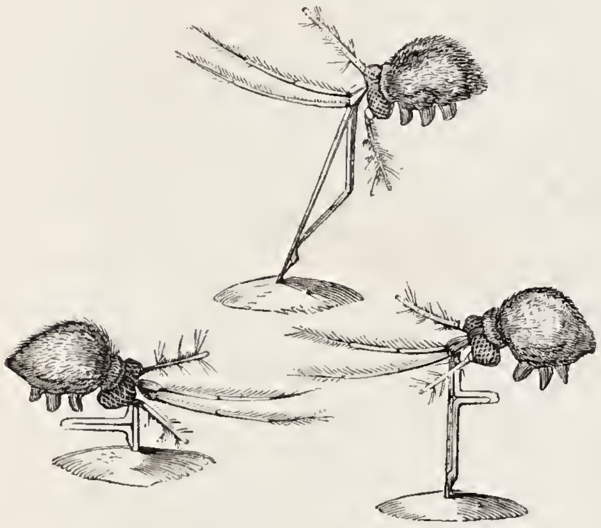


3354.—Brown Oak-Aphis.

3363.—Sucker, &c. of Cleg.

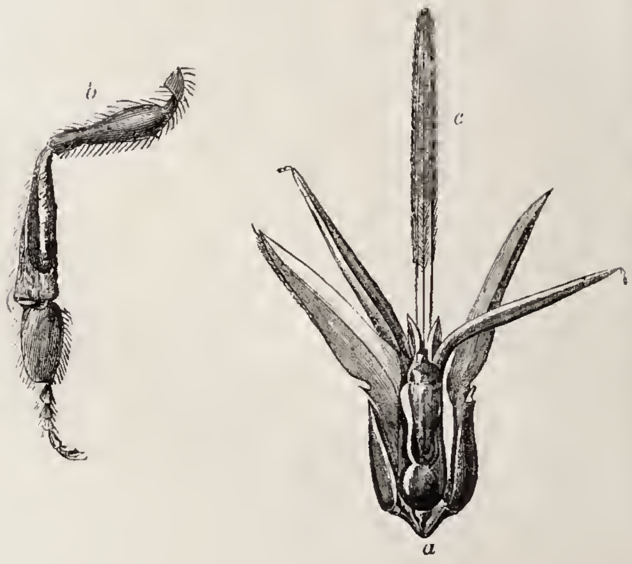


3360.—Sucker of Gnat.

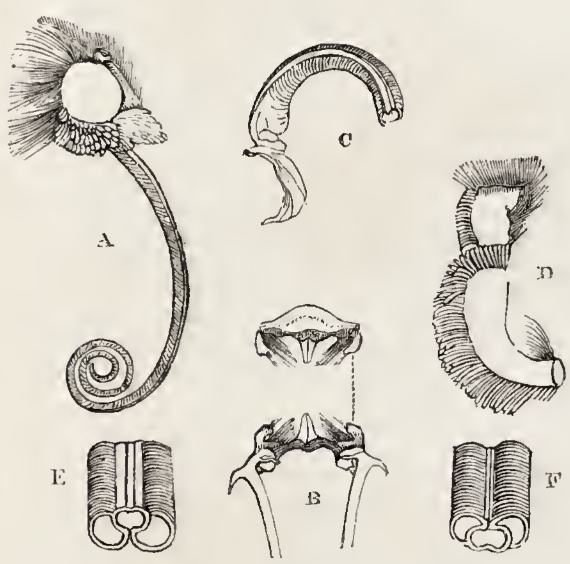


3361.—Gnats applying Suckers to the Skin.

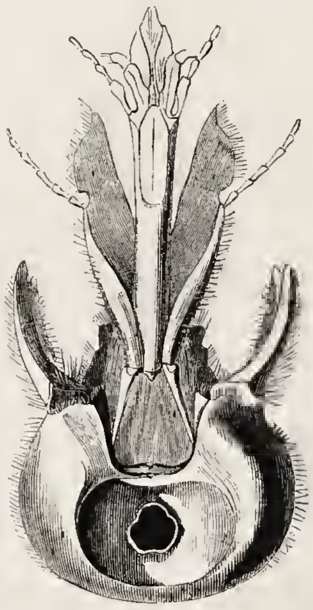
3352.—Larkspur and Columbine.



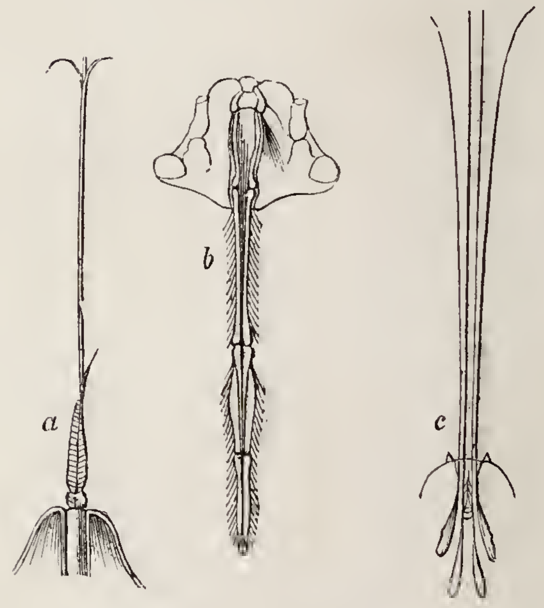
3350.—Tongue of Hive-Bee.



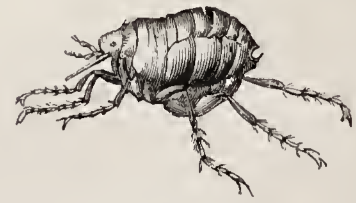
3353.—Mouth of Moth.



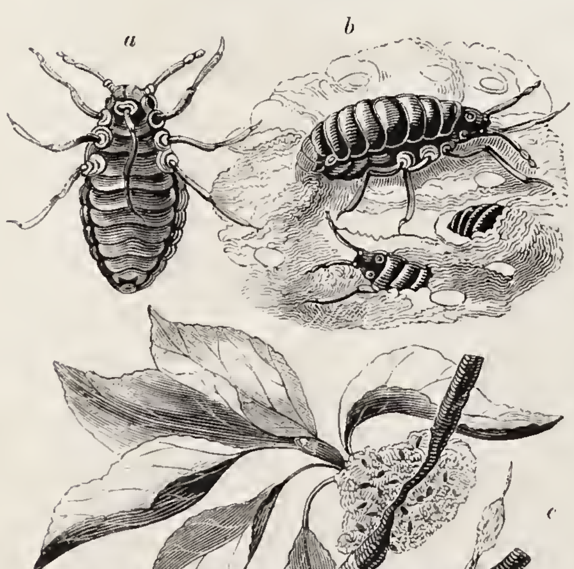
3351.—Head of Bee.



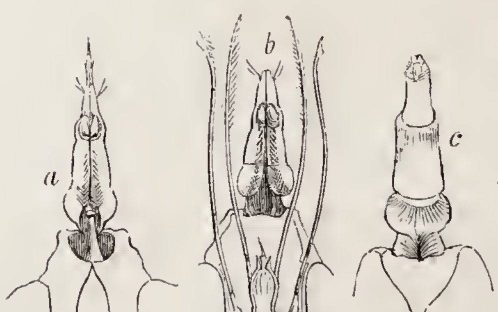
3356.—Suckers of Plant-Bugs.



3359.—Chigoe.

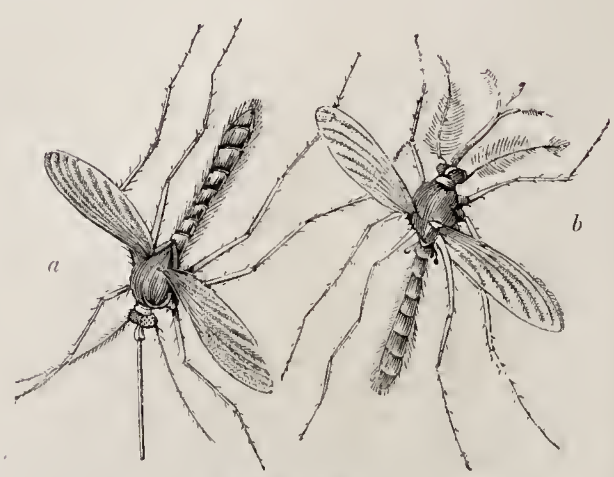


3355.—Apple Aphis.

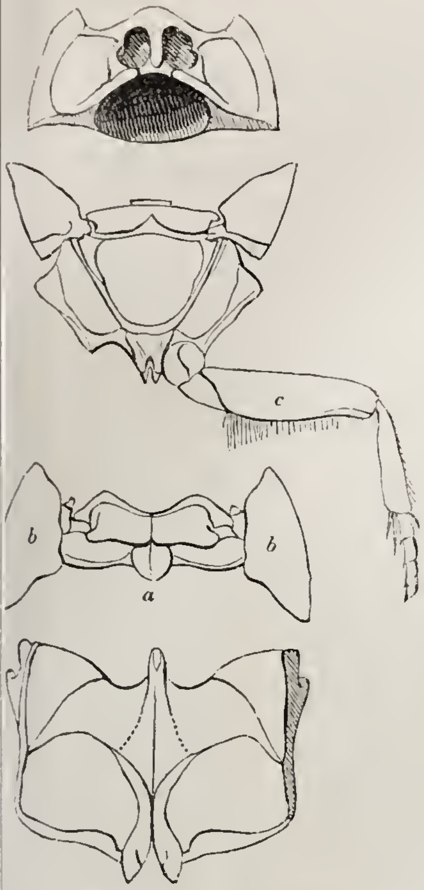


3357.—Sucker of Water-Bug.

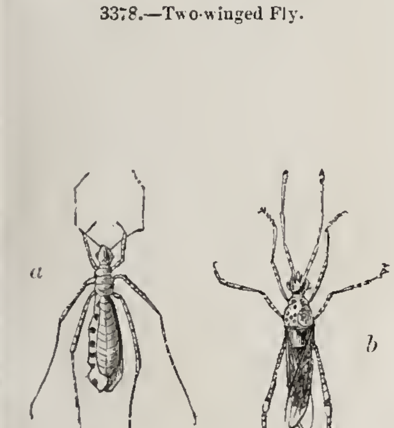
3358.—Sucker of Flea

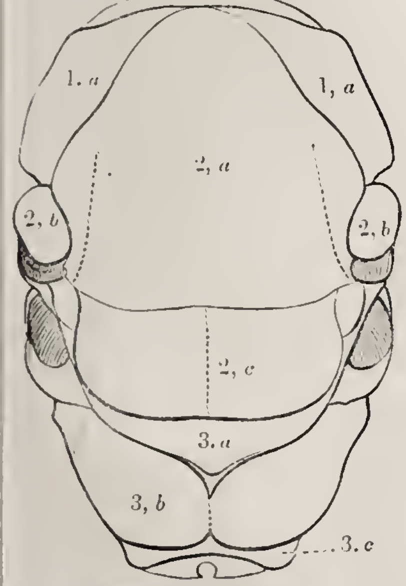


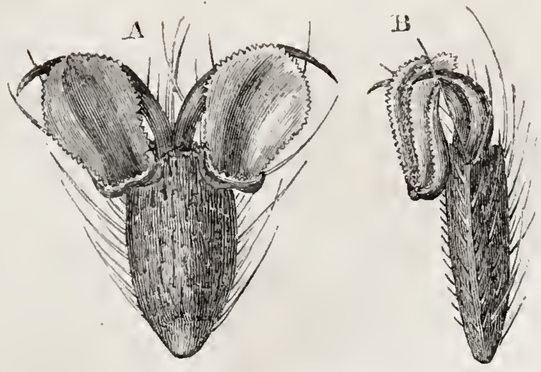
3362.—Male and Female Gnats.

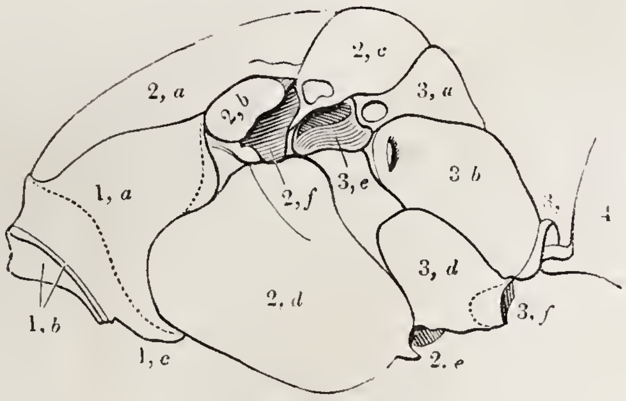

3367.—Parts of Thorax of Beetle.

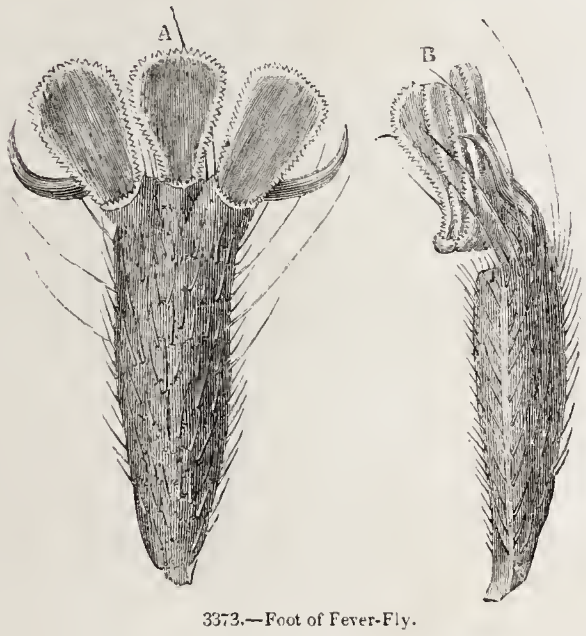

3378.—Two-winged Fly.


3371.—Ploiaria vagabunda and Neides elegans.

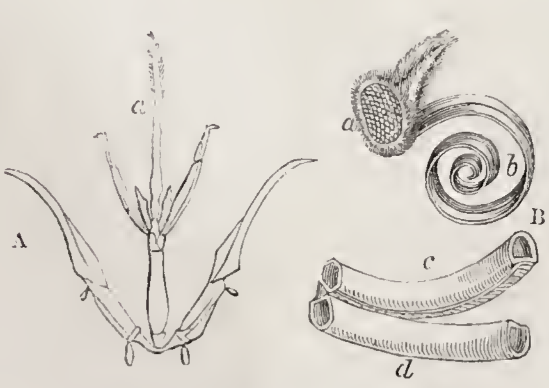

3369.—Thorax of Hornet.

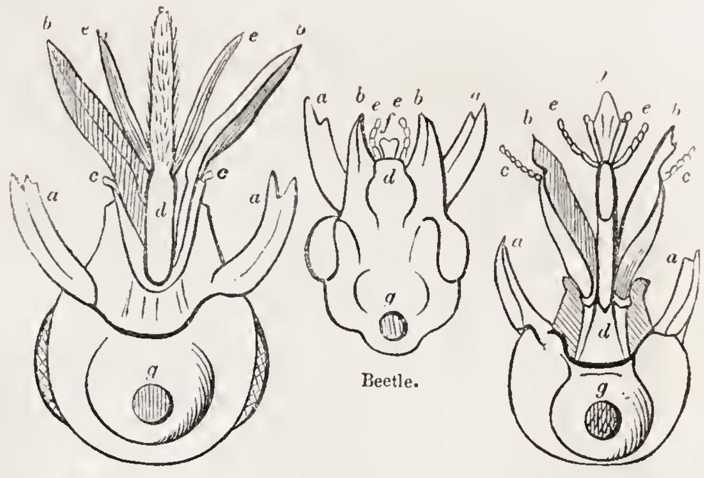

3372.—Foot of Bluebottle-Fly.


3369.—Thorax of Hornet.

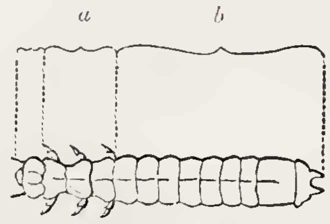

3373.—Foot of Fever-Fly.


3374.—Flea.

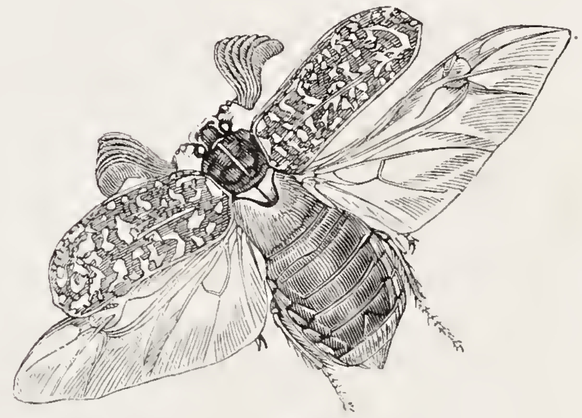

3365.—Proboscis of Bee and Butterfly.


Beetle.

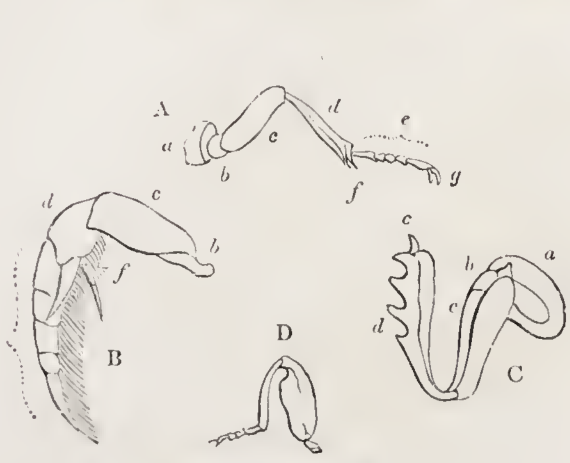
3464.—Humble Bee. Hive-Bee.


3366.—Caterpillar.


3375.—Velvet Spring-tail.


3376.—Beetle flying.


3377.—Wings of various Insects.


3370.—Legs of Beetle.

In the common house-fly the mouth is elongated into a flexible proboscis, terminating in fleshy sucking lips, and this proboscis when not in use is folded under the head; in Tabanus, the Horse-fly, the proboscis is formidably armed with knives or lancets for making an incision into the skin; they are five in number, the upper pair representing the mandibles, the lower the maxillæ, and the middle one the tongue. Their sheath represents the labium.

The keen and long sucker of the gnat is represented at Fig. 3360: *a*, the sucker in its sheath; *b*, half of the sheath removed to show the piercing instrument; *c*, the whole separated to show the distinct parts; *d*, the serrated point of one of the cutting blades. The sheath is flexible and of use in supporting the cutting instruments while they pierce the skin. At Fig. 3361 is displayed the manner in which the gnat applies its instruments to the skin; they exemplify the use of the sheath, the extremity of which is introduced into the wound, which is of considerable depth, and, in consequence of some poisonous secretion instilled into it, produces pain, inflammation, and swelling. In many countries gnats and mosquitoes are serious pests; they make their attacks not in armies of thousands, but in clouds of countless myriads, and the destruction of whole hosts only makes room for the sanguinary assaults of others. No dress can prevent their attack; Humboldt assures us that "between the little harbour of Higuerote and the mouth of the Rio Unare, the wretched inhabitants are accustomed to stretch themselves on the ground and pass the night buried in the sand three or four inches deep, exposing only the head, which they cover with a handkerchief."

Fig. 3362 represents the male gnat; *a*, the female gnat (Culex pipiens) magnified.

Fig. 3363 shows the sucker of a distinct species, the Cleg (Hæmatopota pulvialis). *a*, the insect of the natural size; *b*, part of the head magnified; *c*, the same still more magnified, showing the eye with its facets, the short antennæ, and the sucker unsheathed; *d*, the lancets of the sucker separated to show their form.

By way of concluding our observations on the mouths of insects, we refer to the subjoined illustrations.

Fig. 3364 represents the head of the humble-bee, beetle, and hive-bee—*a a*, the mandibles; *b b*, the maxillæ; *c c*, the maxillary palpi; *d d*, the labium; *e e*, labial palpi; *f*, the tongue; *g*, the articulation of the head to the thorax.

Fig. 3365 shows the so-called proboscis of the bee, compared with the true proboscis of the butterfly. A, the proboscis of the bee; *a*, the tongue for licking up honey: B, the head of the butterfly; *a*, the compound eye; *b*, the proboscis partly unfolded; *c* and *d*, a portion of the tubular proboscis highly magnified.

We may now say a few words respecting the thorax of insects, with which the limbs and wings are connected. The thorax consists of three segments consolidated together, respectively named Prothorax, Mesothorax, and Metathorax; these terms indeed rather apply to the upper than the under surface, for the under part of the prothorax is called prosternum; of the mesothorax, mesosternum; and of the metathorax, metasternum; but this seems to be carrying nomenclature too far. The prothorax carries the first pair of legs; the mesothorax the second pair, and the first pair of wings, or in their stead the wing-cases (elytra); the metathorax supports the third pair of legs, and the second pair of wings.

The number of segments in the abdomen is nine. Fig. 3366 represents the larva of an insect, showing the three segments of the thorax, and the nine segments of the abdomen—*a*, the thorax; *b*, the abdomen. Fig. 3367 displays the parts of the thorax of a water-beetle, Dyticus marginalis: A, the under side of the prothorax: B, the upper side of the mesothorax, called also mesonotum; *a*, the scutellum; *b b*, the basal portions of the elytra: C, posterior view of the same; *c*, one of the middle pair of legs: D, under side of the metathorax.

Fig. 3368 represents the upper surface of the thorax of the hornet. 1, prothorax; 2, mesothorax; 3, metathorax; 1, *a*, scutellum; 2, *a*, scutum; 2, *b*, squamula; 2, *c*, scutellum; 3, *a*, præscutum; 3, *b*, scutellum: 3, *c*, postscutellum.

Fig. 3369, the side view of the thorax of the hornet. The figures and letters refer to the same parts as in the preceding, to which may be added 1, *b*, præscutum and scutum; 1, *c*, situation of anterior pair of legs; 2, *d*, sternum; 2, *e*, situation of middle pair of legs; 2, *f*, situation of anterior pair of wings; 3, *d*, metasternum; 3, *e*, situation of posterior pair of wings; 3, *f*, insertion of posterior pair of legs; 4, commencement of abdomen.

With respect to the limbs of insects, it may be remarked that, as in Mammalia, they are constructed for very various uses, as running, leaping, burrowing, swimming, &c., and consequently are variously modified in detail.

Referring to Fig. 3370, we may observe that they are divided into five principal parts:—The coxa, or hip, A and C, *a*, which is the first joint, or that next to the body. The trochanter, A, B, and C—*b*; the femur or thigh, *c*; the tibia or shank, *d*; and lastly the tarsus or foot, *e*, never composed of more than five joints, and often ending in two hooked claws, A, *g*, called unguiculi. The apex of the tibia is often furnished with two spines called calcarea, A and B, *f*. To this we may add that A represents a limb formed for running: B, a paddle-shaped limb for swimming: C, a limb suited for burrowing: D, a limb endowed with the power of leaping, the thigh being voluminous and muscular.

In some insects, as the Crane-fly, or Long-legs (Tipula oleracea), the limbs are extremely long, slender, and oscillating, enabling the animal to walk amidst the grass elevated as if on stilts; indeed insects thus borne up and kept free from the dew, may be called grass-waders. Many of the plant-bugs have extremely long limbs on which they stalk along in a series of jerking movements. Fig. 3371 shows two insects of this tribe—*a*, Ploiaria vagabunda, and *b*, Neides elegans.

No one can have failed to observe how flies and other dipterous insects walk up the glass of a window, or traverse the ceiling of a room. If we examine the feet of a fly we shall find them furnished under the last tarsal joint with two palmated discs, which act as suckers, being each closely adpressed to the surface. Besides these suckers they have also hooks which enable them to cling where rugosities afford the facility. In this apparatus we are reminded of the Gecko lizard. The suckers of the fly are concave underneath, and when in action, are separated from each other and expanded like the terminal sucker of a leech, the air being sufficiently expelled beneath, so as to induce a degree of atmospheric pressure sufficient to keep the insect from falling. The suckers are margined with minute serrations and covered with exquisitely minute down.

Fig. 3372 represents the foot of the common Bluebottle-fly magnified six thousand four hundred times. A, a view of the under surface of the suckers, seen expanded when the insect is walking against gravity; B, a lateral view.

The Fever-fly, Bibio (Tipula) febrilis, has three of these suckers. See Fig. 3373—A, the under surface; B, a lateral view.

Suckers, however, are not confined to the limbs of climbing insects. We find them in the first and middle pair of limbs of the males of the Dyticus marginalis, or water-beetle. In the anterior legs the three last joints of the tarsus are so dilated as to form a broad circular palette covered on its under surface with numerous suckers, of which one exceeds the rest in magnitude. The middle pair of limbs have the tarsi furnished with a number of small suckers, forming together an elongated cluster. The male of this beetle may be known at a glance by the smooth elytra; in the female they are furrowed.

In the Blatta, Phasma, and Mantis, the limbs are provided with foot-cushions variously arranged, which appear to act as suckers. In the genera Locusta and Acridium, De Geer found a true claw-sucker, as well as tarsal cushions, but the crickets (Gryllus) have neither suckers nor cushions.

The hind limbs of the Dyticus are, as we have seen, adapted as swimming paddles, by means of which the beetle ploughs its way through the water with great vigour. The form is oval and depressed, and its horny integuments are lubricated by some subtle oleaginous fluid which effectually repels the water. The coxæ or haunches are not free, but fixed immoveably, and are greatly developed for containing the voluminous muscles required to work the paddles. Their fixedness adds to the precision and vigour of the movements of these limbs, which are parallel to the axis of the body. The Water-boatman, Notonecta glauca, the rapid Whirlwig (Gyrinus natator), the Water bug (Gerris lacustris), the Water-measurer (Hydrometra stagnorum), are familiar examples of aquatic insects.

Among insects formed for leaping we may instance that little disturber of repose, the flea (Pulex irritans), the grasshopper, the tree-hopper (cicada), the cricket, &c. Aristophanes, by way of ridiculing Socrates (Nubes), represents him as having measured the leap of a flea. Since the days of Socrates many philosophers have brought themselves within the lash of the satiric Greek poet, and have measured the leap both of this and other insects. The flea will propel itself to a distance measuring two hundred times the length of its own body; and a locust will do the same, but the latter vibrates its wings by way of aiding itself. The leap of a horse, at the same comparative ratio as that of the wingless flea, which is effected by one muscular effort, would be nearly fifteen thousand feet. Fig. 3374 represents the flea, magnified.

Among leaping insects we may specify the Podura aquatica, and the velvet spring-tail (Podura holosericea). The latter, a minute insect, in addition to its limbs, uses its tail as a sort of spring, and propels itself to a great distance. Fig. 3375 shows the velvet spring-tail in the leaping position, magnified.

We may here glance at the wings of insects, a subject to which we must again advert when we come to notice the transformations of these creatures, and the mode in which they become developed into maturity. These organs are two or four in number, of a membranous and often extremely delicate texture, various marked by nervures, which Jurine has demonstrated to be air-tubes continued from the body. Delicate as are the wings, they are composed of a double membranous tissue, between which the nervures ramify, often so minutely (in the Dragon-fly for instance) as to represent exquisite lacework. They vary greatly in relative extent and outline, and also in their position when at rest: sometimes they are elevated; sometimes they cross each other, and sometimes are extended; in many tribes they are folded up, somewhat like the wings of a bat, and hidden under wing-cases, or elytra, of more or less rigid consistence. This latter mode prevails throughout the coleoptera; which, instead of having anterior wings, have these opaque portions under which the true wings are folded when at rest. During flight the elytra are extended, and give increase of surface, without additional weight to the "shard-borne beetle." In none of the coleoptera are these elytra wanting, though in some species the wings themselves are undeveloped. In many insects, as butterflies and moths, the nervures and tissues of the wings are hidden by minute scales and plumes, which beneath a microscope present very beautiful objects. These scales, which to the naked eye appear like fine dust, are variously arranged, but mostly in an imbricated manner, with more or less regularity. They are inserted into the membrane by a short footstalk or root, but their attachment is comparatively slight, whence they are brushed off by a touch. Not only are they often richly coloured, but they are marked with striæ, and often crossed by finer lines, and these striæ, by the reflection of the light at different angles, produce varying tints of brilliant or metallic effulgence. Some idea of the almost endless variety of form and markings which the scales of moths and butterflies assume may be conceived when we state that Lyonnet nearly fills six quarto plates with crowded delineations of those of one species, viz., the Bombyx Cossus. The number of those scales on the wings of a large butterfly almost defy calculation. Leeuwenhoek counted upwards of four hundred thousand on the wings of a silk moth, and it is estimated that in one square inch of a butterfly's wing the number of scales will amount to one hundred thousand seven hundred and forty. When these scales are rubbed off, the wings will be found to consist of an elastic transparent membrane, exhibiting beneath a microscope indented lines, according to the arrangement of the scales. In the scales of the wings of butterflies with iridescent colours, we are forcibly reminded of the scaly feathers of the humming-bird. (Vol. i. p. 379, note.)

We must not omit here to state that dipterous or two-winged insects, as the fly, the tipula, &c., have below the wings on each side a slender peduncle terminated by a bulb or club; these are termed halteres, balancers, or poisers; and they vary in length in different species; and from experiments that have been often repeated it appears that they steady the body during flight. Above these balancers is a little scale or winglet (alula), formed of two portions joined together at one of the edges, and not unlike the two valves of a shell. The use of these winglets is not very clear; Scheler found that if removed from a fly, the power of buzzing ceased, and moreover that the faculty of flight was destroyed, as much so as by the removal of the balancers; these latter he conjectures to be filled with air, and to serve as a sort of reservoir.

In some dipterous insects, the balancers are situated at the anterior part of the thorax; Latreille terms them "prébalanciers."

Referring to our pictorial specimens, Fig. 3376 represents a large beetle, with the elytra spread in flight and the membranous wings displayed at full stretch. Fig. 3377 represents the wings of several insects—*a*, the wing of a beetle; *b*, the wing of an earwig; *c*, the wing of the saw-fly; *d*, the wing of a crane-fly; *e*, the wing of a common fly; *f*, the wing of a midge (Psychoda).

Fig. 3378 represents a dipterous insect, Volucella plumata, in which the winglets are very distinctly seen.

Fig. 3379 represents that well known fly called father long-legs—A, *a a*, the poisers or balancers: B, the poisers of another fly, seen at *a a*: C, the poisers, seen at *a a*; *b b*, the winglets.

Fig. 3380, the under surface of a dipterous insect, showing the poisers very distinctly, and also the nervures of the wings; together with the terminal suckers of the feet.

Figs. 3381, 3382, and 3383 show the feathered and sealed character of the wings of moths; among these insects the plume-moths (Alucitidæ) are exceptions as it respects the structure of the wings; these, instead of consisting each of one single piece, are composed of numerous distinct shafts, fringed with most delicate barbs or cilia, like a downy feather. The white-plume moth (Pterophorus pentadactylus, Leach; Alucita pentadactyla) is by no means uncommon, during the summer, along hedgerows, slowly winnowing its way, like a flake of snowy down.

Fig. 3384 represents—*a*, the twenty-plume moth (Alucita hexadactyla), of the natural size; *b*, the same magnified: *c*, the white-plume moth.

When we consider the ease and velocity with which insects fly, the extreme rapidity of the vibrations of their wings, at least in many species, which the eye cannot follow, and the length of time they are capable of continuing on the wing, we may readily conclude that the muscles destined for moving these organs must possess extraordinary vigour and power of endurance. M. Chabrier describes two sets of muscles in the diptera, appropriated to the wings, a dorsal series placed lengthwise in the thorax for lowering the wings, and the sterno-dorsal, passing obliquely across the former; these raise the wings. In the dragon-flies there is another set of muscles, called pectoral, placed lengthwise, and inserted immediately into the wings.

Figs. 3385 and 3386 show the muscles of flight in a dipterous insect (Syrphus inanis): *a*, part of the abdomen; *b*, the costo-dorsal muscles; *c*, and *d*, the sterno-dorsal muscles; *e*, part of the head.

We may now pass on to a consideration of the circulation and respiration of insects.

Insects breathe through a series of pores disposed in regular succession along the sides of the chest and body. These orifices are termed spiracles or stigmata. In many instances they may be seen with the naked eye; and though in some species they are always open and circular, in others they are capable of being closed and opened alternately. In numerous insects they are defended by a pencil of hairs, in order to prevent the intrusion of dust or foreign particles. These spiracles generally lead to two main internal branches running longitudinally, and termed tracheæ, whence multitudes of tubes are given off dividing almost ad infinitum and penetrating every part. These tubes generally appear to be simple, but sometimes assume a bearded appearance, and sometimes numbers of them are dilated at certain intervals into sacculi or reservoirs, partly, perhaps, for the preservation of air, and partly, perhaps, as in the sacculi of birds, to lighten the specific gravity of the body during flight. These tubes, however, are not confined to the body, they are continued into the wings, constituting, as already stated, the nervures; and in such insects as fold up the wings, most naturalists, we believe, consider that it is by forcing the air into these tubes that the expansion of the wings for flight is effected. Thus, then, insects may be said to be permeated by air; and to this circumstance their vigour and energy are greatly owing, for every part of their organization, their muscles, and the nutritive fluids, are under the constant operation of oxygen. The multitude of these air-vessels is not less surprising than their structure. As far as observation has hitherto gone, the tracheæ at least are found to consist not of a simple membranous tissue forming a cylinder, but of two exquisitely fine membranes, between which a spiral thread is interposed so as to form by its close gyrations a cylinder like the worm spring of wire used in bell-hanging. The object of this wonderful contrivance is to give firmness to the tubes without interfering with their flexibility, and to prevent their collapse, without their being rigid or coriaceous. The external signs of respiration are not always to be perceived in insects; in some, however, as the bee, the great dragon-fly, and the large green grasshopper, it is indicated by the alternate expansion and contraction of the abdomen, which M. Chabrier has described in detail. In the grasshopper M. Vauquelin found the inspirations to be fifty-five times in a minute. According to De Geer, Lyonnet, Bonnet, and other observers, the lining membrane of these respiratory tubes (and also of the alimentary canal) is cast off by caterpillars at the epoch in which they change their skins. De Geer states that he has seen white fibres proceeding from the spiracles of a butterfly, attached to the newly rejected pupa-case; and he conjectures that these fibres are really the delicate lining membrane of the respiratory tubes, which are mounted like the lining of the stomach of a lobster or caterpillar.

Swammerdam in his description of the Rhinoceros Beetle (Oryctes nasicornis) enters at length into this wonderful exuviation. At Fig. 3387 are displayed the exuviæ and pulmonary vessels of the larva of the rhinoceros beetle. A, a magnified view of a pulmonary branch and vesicle; *a*, *a*, pulmonary branch composed of a membranous sheath and cartilaginous rings: B, the larva; *c*, *c*, nine reddish spiracles or stigmata: C, the cast slough of the caterpillar, showing at *d*, *d*, the lining of the respiratory tubes.

With the function of respiration the circulation of the blood is intimately connected. In most animals we discover a more or less perfect system of bloodvessels, namely, arteries and veins, but in insects a complete vascular system cannot be detected; not indeed that bloodvessels are wanting, for a dorsal vessel extending down the back is very apparent, exhibiting a series of pulsations towards the head, and in transparent caterpillars this vessel with its pulsatory movements may be seen with the naked eye.

We may here observe that the chyle, or nutritive portion of the digested food, appears to percolate through the walls of the alimentary canal, filling up every space internally, bathing the fine air tubes, and thus subjected to the action of oxygen becoming altered in character and analogous to the blood of other animals. Such at least is the general theory.

Now to revert to the dorsal vessel. According to Lyonnet this vessel contains a fluid, at first appearing colourless, but which when collected in drops is found to be of a yellow tint more or less deep. A powerful microscope shows it to be filled with globules of inconceivable minuteness. When this fluid is mixed with water, the globules lose their transparency and coagulate in small clammy masses, which after evaporation become hard and brittle like gum. The nature then of this fluid, and the regular pulsation of this vessel, favour the idea of the latter being a kind of heart. Swammerdam indeed asserts that he has seen tubes issuing from this dorsal vessel, which he has succeeded in filling with a coloured fluid; but Cuvier and most writers have stated that it is not only closed at each end, but that there are no tubes leading to it or issuing from it, as is proved by the most elaborate researches. Lyonnet, who traced the nerves and the ramifications of the respiratory tubes of inexpressible minuteness, could not detect, after the most painful investigations, either veins or arteries; but the vessel appeared to him to be open at the anterior end.

Marcel de Serres states that the vessel can be removed without causing the immediate death of the insect; and some physiologists have been inclined to regard it as a secretory organ, but of what kind it was impossible to conjecture. We do not think this theory very tenable.

According to Meckel, it is furnished with longitudinal muscular fibres; but Strauss Durkheim found it, in the Chaffer at least, to consist of an outer membrane, and an inner lining of circular muscular fibres. Strauss Durkheim's description of this dorsal vessel is very curious, and seems in some measure to reconcile the conflicting views, which have arisen from the observations of other microscopic anatomists. This vessel, he states, is divided in the chaffer into eight compartments by a series of semi-lunar valves, so constructed as to allow of the advance of the fluid from the contraction of the vessel from the tail upwards from the head, but not of its retrograding. At the anterior part of the vessel the fluid issues through a perforation into the general cavity of the body, and meanders in streams between the various tissues; but as at each contraction or systole the vessel exhausts itself, there must be some means for keeping up a continual supply. It appears that each chamber has a valvular orifice on each side, communicating with the cavity of the body, and the valves are so ordered as to permit the influx of blood, but not the efflux; hence, as the vessel dilates after each contraction a quantity of blood is sucked in, which, as it cannot return by the same openings, must go forwards, from the structure of the internal semi-lunar valves, and is thus kept in perpetual circulation. Hence, therefore, though exclusive of this long dorsal vessel there is no vascular system, regular currents of the fluid, bathing the viscera, the muscles, the air tubes, and other organs, are maintained. Both the contraction and the dilatation of this kind of heart begin from the posterior chamber, and so upwards in rotation. The number of contractions varies; they have been counted from twenty to a hundred per minute. The extent and divisions of this vessel differ in different insects. Such is an outline of the account given by Strauss Durkheim.

More recently Professor Carus has published his observations on the circulation, as investigated by himself in certain very transparent insects; and in addition to the meandering streams evidently not confined by vessels, he considers that there is also a vascular circulation; that besides the main current discharged from the anterior orifice of the heart, "another portion of the blood is conveyed by two lateral trunks, which pass down each side of the body in a serpentine course, and convey it into the lower extremity of the dorsal vessel from which they are continuous." Dr. Roget, in his 'Bridgewater Treatise,' figures this kind of circulation in the sembla viridis, from a delineation by Carus in the 'Acta Acad. Cæs. Leop. Carol. Nat. Cur.,' vol. xv., pt. II., p. 9. It appears that these lateral vessels give off others, which in the form of loops supply the antennæ, the tail, the limbs, and wings, and return the blood to the lateral vessels, and these again merge into the dorsal heart. A similar circulation is asserted to exist in the Ephemera marginata, figured and described in Dr. Goring and Mr. Pritchard's 'Microscopic Illustrations,' and fully detailed and illustrated by Mr. Bowerbank, with an engraving on a large scale, in the 'Entomological Magazine,' i. 239, pl. 2.

With the respiration of insects is doubtless connected many of the noises or sounds which they utter during flight, and while at rest; and it is probable that they have the power of directing currents of air to any special organ. Messrs. Kirby and Spence consider that the vocal spiracles of the Hymenoptera and Diptera are those behind the wings; we have indeed frequently held a fly, securing its wings, and watched, as it buzzed, the rapid tremulous vibrations of the alulæ; but when the wings have been removed the cry was short and acute, and it appeared to us that the full-toned buzz was produced by the air driven against the edge of the wings, in which, secured as they might be, there was always a sensible tremor, that of the alulæ being more decided. The wasp-fly (Chrysotoxum fasciolatum), Fig. 3388, is capable of buzzing when at rest.

The males of the crickets, grasshoppers, and locusts (Orthoptera), produce their cry or chirp by applying the hind shank to the thigh, and rubbing it smartly against the wing cases; but they have a sort of drum or sounding-board "on each side of the first segment of the abdomen, immediately above the origin of the hind thighs; it is in the form of a large opening or pit, somewhat oval in outline, and partly closed by an irregular flat plate or lid of a hard substance, but covered by a flexible wrinkled membrane. The opening left by the lid is in the form of a half moon, and at the bottom of the cavity is a white membrane shining like a mirror and tensely stretched. On each side of the opening towards the head there is a small oval orifice, into which the point of a pin may easily pass, and when the membrane is removed a large cavity is brought into view." The whole of this apparatus, says De Geer, seems to contribute much to produce and increase the sound caused by the insects.

Fig. 3389 represents this apparatus: A, the first ring of the abdomen magnified; *a*, a deep cavity partially covered by the plate *b*: B, the cavity with the parts as they appear when the plate *b* is removed; *c*, the white membrane stretched across the cavity; *d*, the oval orifice.

The field-cricket (Acheta campestris) is kept in cages by the Spanish peasantry, who delight in its querulous chirping. Our reader will remember the quarrel between two boys respecting a cage full of crickets which gave Don Quixote so much annoyance, but which was ended by the squire making a purchase of the chirping brood for four farthings.

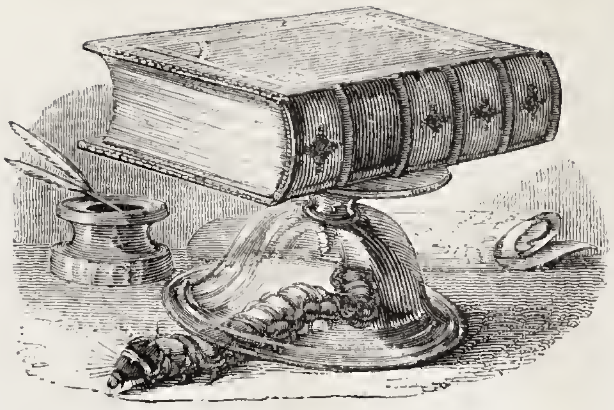
From time immemorial have the tree-hoppers, Cicadæ, been celebrated for their music:—

> "Et cantu querulæ rumpent arbusta cicadæ." VIRGIL.

The musical instrument of this species (order Homoptera), the τεττιξ of the Greeks, has been described by Réaumur. It is present only in the male, and consists of two pairs of large plates, fixed to the trunk between the abdomen and hind legs. When this exterior membrane is raised, a cavity is exposed, part of which seems to extend into the abdomen, and part to be covered with a second membrane, much more delicate than the exterior one, tensely stretched and iridescent; in the middle there is a horny plate placed horizontally along the bottom. All this, however, forms but a secondary portion of the instrument, for the sound is in the first instance produced by a bundle of muscular strings, which are attached at one extremity to another membrane in the interior, obviously the true drum; for when Réaumur pulled these strings and let them go, the sound was produced for some time, even after the death of the insect. These muscles, he states, are so attached to the under concave surface of the drum, that when they pull it downwards and let it jerk quickly back again, a vibration is produced, and the sound issues through an opening like that of the larynx of quadrupeds, or the sound-hole of a violin.

Fig. 3390 displays the under side of a cicada with the external plates visible.

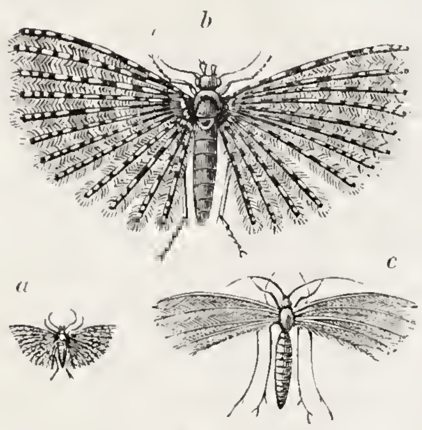
3379.—Father Long-legs.



3396.—Caterpillar escaping.

3390.—Under Side of Tree-hopper.

3391.—Drums of Tree-hopper.

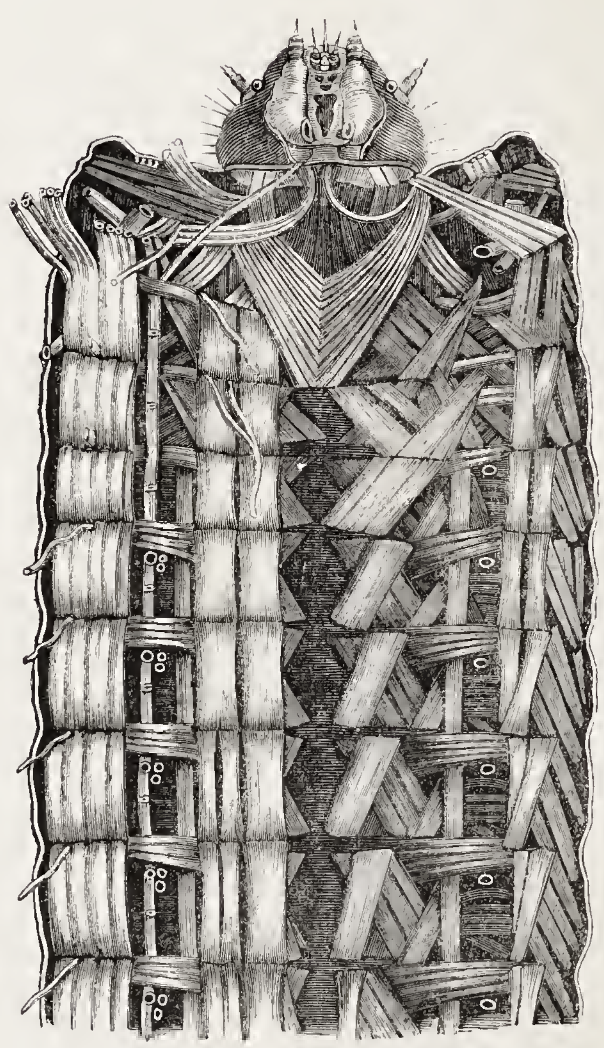


3384.—Twenty-plume Moth and White-plume Moth

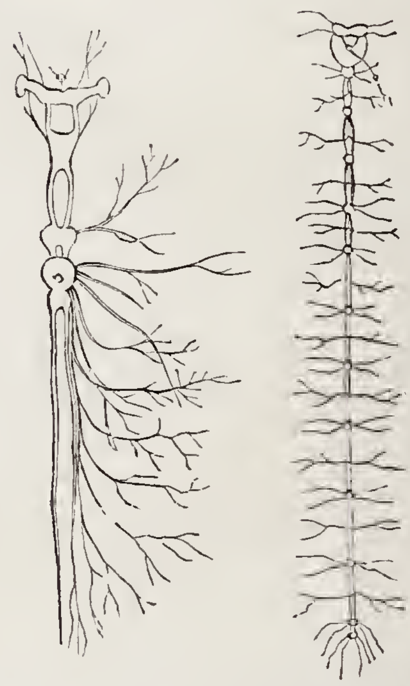
3388.—Wasp-Fly.

3393.—Head of Death's-Head Hawk-Moth

3381.—Moth.



3395.—Muscles of Caterpillar of Goat-Moth.

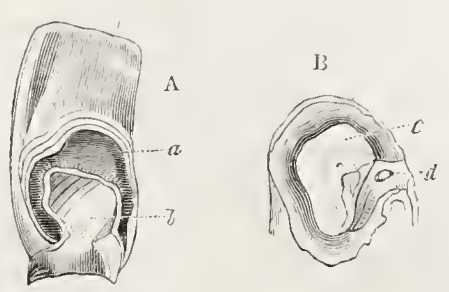


3394.—Nervous System in Chaffer-Beetle and Larva.

3382.—Moth.

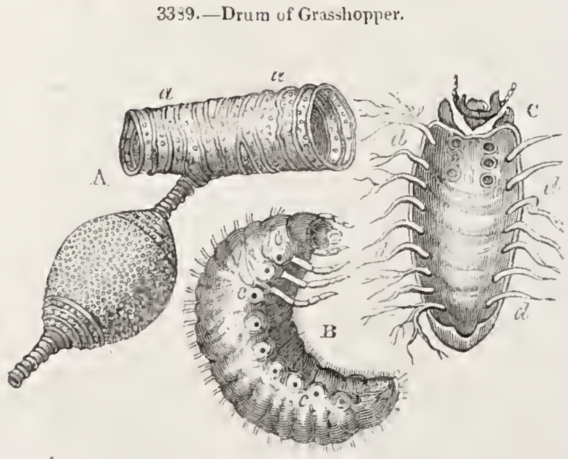
3383.—Moth.

3392.—Death's-Head Hawk-Moth.

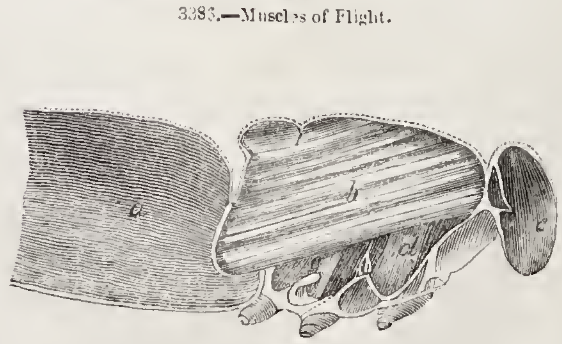


3389.—Drum of Grasshopper.

3386.—Muscles of Flight.

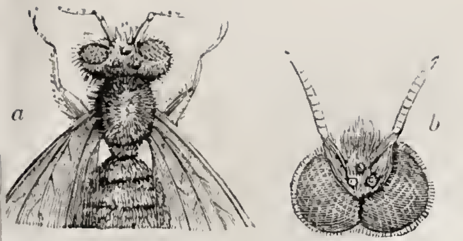


3387.—Details of Rhinoceros Beetle.



3385.—Muscles of Flight.

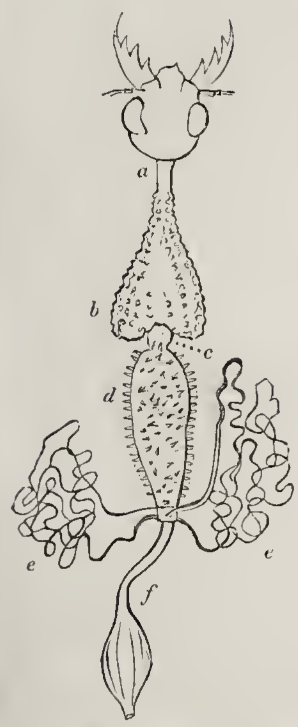
3380.—Under Surface of Two-winged Insect.



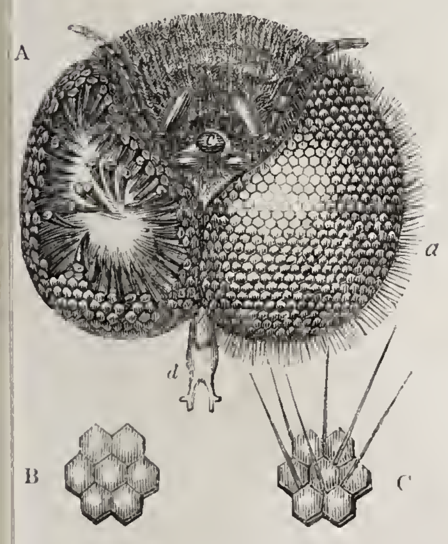
3403.—Eyes of Bees.

3405.—Whirlwig, and Eyes of Ephemera.

3404.—Tetrops præusta, and Eye.

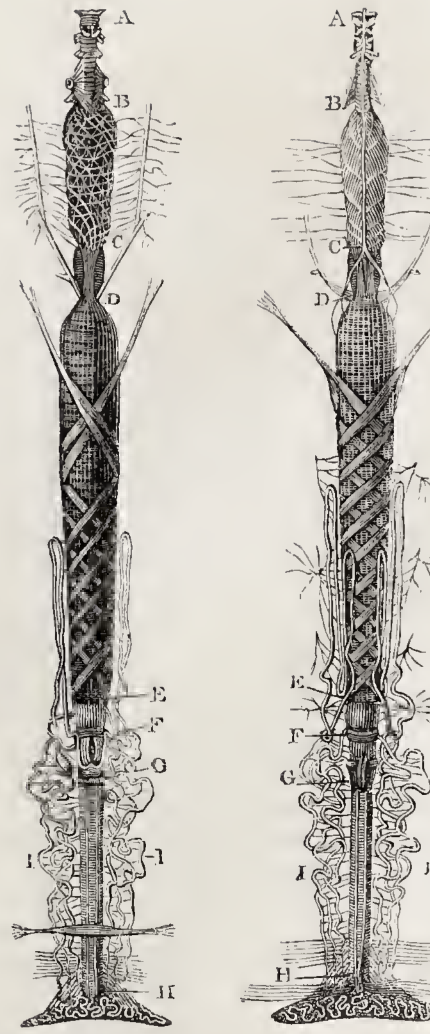


3397.—Intestines of Cicindela campestris.



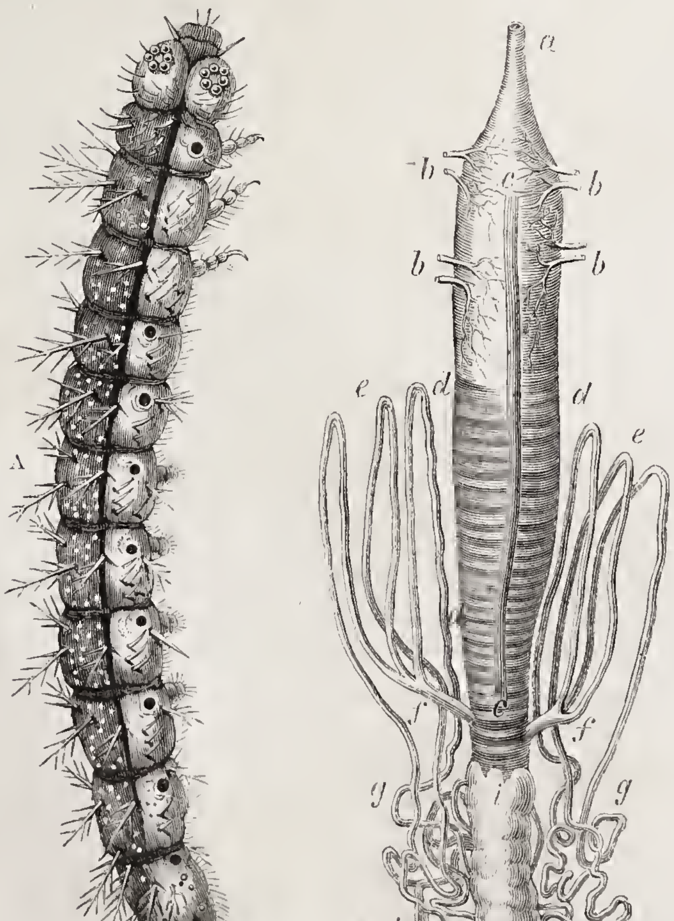
3406.—Eyes of Bee.

3407.—Eye of Dragon-Fly.



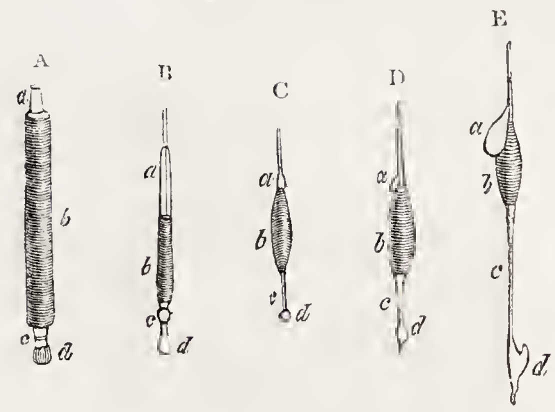
3398, 3399.—Viscera of Goat-Moth.

3411.—Death-watch Beetles.

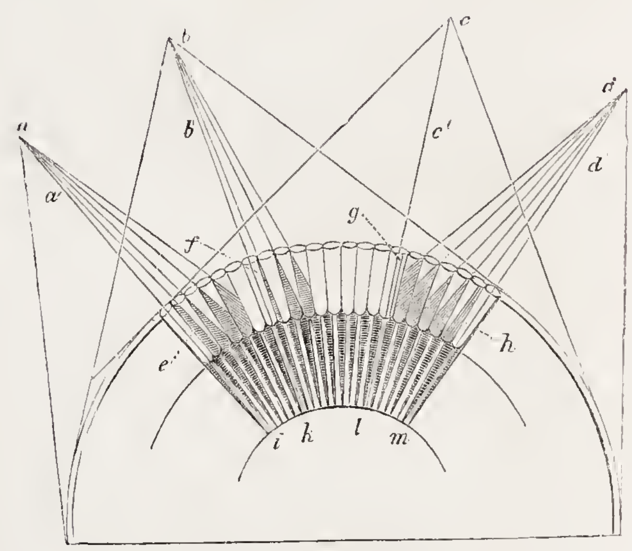


3400, 3401.—Caterpillar and Viscera of Tortoiseshell Butterfly.

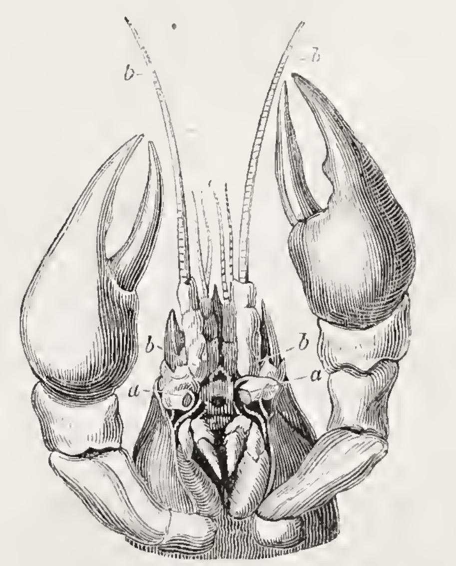
3412.—Acanthocinus ædilis and Adela.



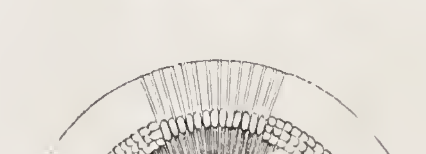
3402.—Intestines of Caterpillar and Butterfly.



3409.—Rays of Light on Eye of Insect.



3410.—Head of Lobster.



3408.—Eye of Stag-Beetle.

Fig. 3391 shows *a a*, the outer drums; *b*, the muscular strings; *c c*, the inner drums.

The Fulgora laternaria of Guiana, an allied form, makes a noise at night so loud and disagreeable as not unfrequently to prevent repose.

Among British insects which utter singular noises, may be noticed that fine species of moth, the death's head hawk-moth (Acheronta atropos), of which we have a pictorial specimen at Fig. 3392.

The cry uttered is a sort of squeak, like that of a mouse, loud, distinct, and piteous. From this cry and the singular markings of the thorax, it has been an object of popular superstition both in our own country and the continent. The mode in which its cry is produced has puzzled numerous investigators, and various and even contradictory explanations have been given, as the result of experiment and observation. Réaumur concluded the noise to be produced by the friction of the palpi against the proboscis, and found, he says, that when he uncoiled the spiral proboscis with a pin, the noise ceased, but was renewed when suffered to curl up again. He found also that by preventing the palpi from touching the proboscis, he could stop the sound. These experiments are represented at Fig. 3393: *a*, the proboscis secured; *b*, the palpi secured. On the contrary, we learn that after the extirpation of these parts, as tried by M. de Johet, the noise continued to be produced, accompanied by a shivering of the wings, under which, at their base, the experimenter found two scales, and these being cut away the insect became mute, and he attributes the cry to the action of the air forced out of spiracles against these scales. M. Lorrey again says that the sound arises from air escaping rapidly through peculiar cavities on the sides of the abdomen, furnished with a fine tuft of hair and communicating with the spiracles. MM. Passerini, Duponchel, and Duméril, attribute it to the impulsion of air into a cavity of the head, furnished with muscles and a sort of tympanic membrane. According to Mr. Raddon this moth is able to produce the sound before quitting the pupa-case. That it is connected with the respiratory organs, we think there is little doubt, but the peculiar mechanism by which it is caused seems to be as yet unascertained. We say nothing here of the noises which insects make, by means utterly unconnected with their respiratory system, as the tick of the anobium or death-watch, produced by the insect rapping with its head against woodwork, into which it bores, or of the timber-louse (Atropos pulsatorius).

We shall here say but little of the nervous and muscular system of insects. With respect to the former we need not repeat that it is ganglionic; but we may state that during the progress of the insect from the larva to maturity it undergoes certain alterations. In the larva the ganglia are numerous and small, and too feeble to animate powerful limbs or receive lively impressions. As the growth of the larva brings it towards the pupa stage, the nervous centres begin to concentrate themselves, several of the ganglia coalescing, and the nervous chords connecting them becoming flexuous. In the pupa this modification is very palpable, and at the same time the wings and limbs with their muscles begin to develope; this concentration goes on till the insect is about to emerge in a perfect state, but varies in ratio according to the organic elevation of the insect in its class. Fig. 3394 shows the nervous system in the perfect chaffer-beetle, and in a caterpillar or larva.

With regard to the muscles of insects, we may conceive that they are well developed and endowed with great vigour when we reflect on the surprising leaps some species are capable of making, and of the untiring flight or aquatic movements of others. It has been calculated that the chaffer-beetle is proportionally six times stronger than a horse. The number of the muscles in these creatures is astounding. Lyonnet counted in the head of the caterpillar of the goat-moth two hundred and twenty-eight; in the body, one thousand six hundred and forty-seven; and around the alimentary canal, two thousand one hundred and eighty-six; deducting twenty as common to the head and body, the total number is four thousand and sixty-one. Of the arrangement of these muscles some idea may be formed by referring to Fig. 3395, a magnified view of the principal dorsal muscles of the caterpillar in question (from Lyonnet).

Fig. 3396 represents the same species of caterpillar escaping from under a loaded glass.

We may now proceed to glance at the digestive apparatus of insects, premising that they possess both salivary and biliary organs, and that saliva and bile are abundant. As in other animals, we naturally anticipate modifications of the nutritive apparatus according to the nature of the food; and that in the voracious caterpillar which devours the leaf, there must occur a great change, in order to fit it for a new existence, when it flits a winged butterfly, sipping the nectar of flowers.

In mandibulate insects, as the beetle, the gullet leads to a crop entering a muscular gizzard resembling that of a fowl, lined with a strong membrane; and sometimes studded with horny plates, or even curved teeth for grinding and tearing. To the gizzard succeeds a true stomach, at the pyloric end of which the biliary vessels, usually four, six, or eight in number, enter. To the stomach succeed the small intestines of varying length, and sometimes not to be distinguished from the large intestines.

In the haustellate insects, as the butterfly, and also in the bee, there is no gizzard, but a honey crop: in the bee it is a simple distention of the œsophagus, but in the butterfly, it is a sac with a narrow neck. The salivary and biliary vessels are long slender tubes convoluted together. There are no absorbents or lacteals on the inner surface of the alimentary canal, as in higher animals; but the nutritive juice appears to transude through the coats of the intestine into the cavity of the body, where it becomes mixed with the blood.

Fig. 3397 shows the alimentary canal of the Cicindela campestris, a carnivorous beetle: *a*, œsophagus; *b*, crop; *c*, gizzard; *d*, stomach; *e*, *e*, biliary vessels; *f*, intestine. This is very simple, but we find it still more so in the plant-eating caterpillars of the moths and butterflies, which in the course of a month devour about 60,000 times their own weight of aliment, and in which the stomach is of enormous volume. Figs. 3398 and 3399 represent respectively the upper and under surface of the digestive organs of the viscera of the goat-moth: A, B, C, the œsophagus and its appendages; D, E, the stomach, embraced by a pair of spiral muscles which act upon it; it merges into a simple large intestinal tube, F, G, H, receiving at G the biliary vessels, I, I, the convolutions of which surround it.

Figs. 3400 and 3401 represent respectively the caterpillar and the alimentary viscera of the Tortoise-shell Butterfly (Vanessa Urticæ). A, the caterpillar magnified; *a*, *k*, the alimentary viscera; *a*, the gullet; *b*, *b*, respiratory tubes; *c*, ligament of the stomach; *d*, *d*, annulations of the same; *e*, *e*, coils of biliary vessels; *f*, their entrance; *g*, *g*, *h*, *h*, their folds; *i*, *k*, intestine.

Fig. 3402 represents the changes that take place during the progress of the caterpillar to the butterfly, in its digestive apparatus. A, Caterpillar; *a*, œsophagus; *b*, stomach; *c*, *d*, intestinal canal. A, pupa two days old, parts lettered the same. B, Pupa eight days old; *a*, dilatation of œsophagus, forming the honey crop. D, Pupa immediately before its transformation. E, Butterfly; *a*, honey crop fully developed.

Let us now pass to subjects more interesting generally than the points of structure just noticed; viz., to the senses of insects and their respective organs.

SIGHT.—If one part more than another in the structure of insects is calculated to excite our astonishment, it will be the structure of the organs of vision, in which a world of wonders is included. We may premise by observing that in the Crustacea the eyes are modelled upon the same general plan as those of insects, and that we purposely deferred saying any thing respecting them till the present opportunity, as our pictorial illustrations refer to the eyes of the latter class.

The eyes of insects are not moveable in a socket or orbit, as those of quadrupeds and birds; they are either simple or compound, and in most insects both are present. The simple eyes are termed stemmata, and are usually three in number, placed so as to form three points of a triangle on the top of the head or the space behind the insertion of the antennæ. Often, however, these simple eyes are not isolated; in this case they are numerous, and collected into groups, the number of which varies. A simple eye consists of a convex smooth transparent cornea, behind which is a globular lens supported by a vitreous humour, upon which the retina is expanded. The whole of this is enclosed in a layer of brown, red, or black pigment, which advancing on the lens, forms a distinct iris, with a central opening or pupil. These eyes appear to be appropriated to upward vision, and bees in which they have been varnished, appear to lose their way.

The compound eyes are generally two in number, one on each side of the head, and mostly, as in the common fly, the dragon-fly, and others, occupy considerable space; in large insects their facets may be seen even without the aid of a microscope. Fig. 3403 represents the eyes of—*a*, a worker bee; *b*, a male bee. The simple eyes or stemmata form three points of a triangle. If we take a common house-fly and examine its large eyes through a tolerably good glass, we shall find these organs to present a regularly tesselated surface, which is indeed made up of a multitude of hexagonal facets divided from each other by distinct partitions. Each facet is the cornea of a distinct eye, provided with its own nerve, retina, lens, iris, and pupil. In the fly four thousand of these eyes (ocelli) make up the whole compound one (oculus). In some dragon-flies there are twelve thousand. Butterflies have upwards of seventeen thousand, and some coleoptera have more than twenty-five thousand. To such gifted beings the fabled Argus must yield the palm.

Though generally insects possess only two of these multi-occllated eyes, yet in some there are four, as in the genus tetrops, in which the facetted eyes are two on each side; and it appears that the males of some of the Ephemeræ have, besides the ordinary simple and compound eyes, a pair of additional compound eyes, on the top of a columnar projection. Fig. 3404 represents, *a*, the Tetrops præusta, a British beetle, and *b*, the two eyes, or rather the divided eye of one side greatly magnified. Fig. 3405 shows, *a*, the large eyes of the whirlwig (Gyrinus natator), placed partly on the upper part of the head for seeing above, and extending underneath the head for seeing in the water below; *b*, the additional eyes of Ephemera, greatly magnified. Fig. 3406 shows the eyes of the bee highly magnified at A; *a*, the eye in its perfect state, covered with the cornea; *b*, an eye from which the cornea and some of the hexagonal facets have been removed to show its structure; *c*, the three stemmata or simple eyes; *d*, the ganglion of the optic nerve. B, a portion of the surface of the eye deprived of its cornea: C, the same covered with the cornea, showing the hairs which spring from it.

These organs have been diligently investigated by many microscopic anatomists, as Hook, Leeuwenhoek, Müller, Dugès, and Strauss Durkheim. According to the latter, the hexagonal facet or cornea of each ocellus is a double convex lens, and behind it is placed a hexaëdral transparent prism analogous to the vitreous humour. Upon the posterior part of this the optic nerve terminates in a minute pyriform bulb; at which point a layer of pigment forms a choroid tunic. With respect to the optic nerves it may be observed that they originate from a common ganglion, derived itself from the supraœsophageal mass; from this common ganglion arise a number of short nerves, which soon unite and form what Strauss Durkheim calls the common or general retina; and from this nervous expansion, multitudes of minute nerves diverge to their respective ocelli, first passing through a layer of pigment, of different tint in different insects. Each of these minute filaments forms, as stated, at the back of its respective ocellus, a special retina of a pyriform figure.

It cannot be doubted but that there are many modifications in the structure of these organs, and from this circumstance, as well as from the minuteness of the eyes themselves, some discrepancies may be expected in the descriptions given by different observers.

Dugès describes the eye of the Dragon-fly as follows:—Each ocellus consists of what he terms a transparent 'corneule,' convex anteriorly, concave posteriorly, but with the concavity less than the convexity. The opaque pigment which invests each ocellus forms a sort of iris at the back of the 'corneule' with a central pupil which transmits the rays of light to a transparent cylinder filled with a vitreous humour, and to this cylinder runs a filament from the optic ganglion direct, without any general retina being formed as described in the Chaffer by Strauss Durkheim.

Dugès notices a small space at the back of each corneule, filled with aqueous humour. Fig. 3407 will serve to render the above brief description intelligible. It is a supposed section of the eye of the Dragon-fly. *a*, *a*, the corneules, behind which is a layer of black pigment, *c*, *c*; then follows a tinted zone *e*, consisting of transparent vitreous cylinders, to which pass the nerves *g*, through a dark pigment, each nerve radiating from the optic ganglion *j*. Fig. 3408 represents the eye of the Stag-beetle (Lucanus Cervus), in which the cornea, *a*, is of extraordinary thickness, each corneule being so much elongated as to appear prism-like.

Fig. 3409 shows the mode in which the rays of light may be supposed to impinge on the different corneules or facets. Mr. Parsons, whose illustrations and details we follow, says,—"If rays of different colours given out from the points *a*, *b*, *c*, *d*, fall upon the eye, the cone *h* will be illuminated throughout its whole length by the ray *d'*, which traverses this cone in the direction of its long axis; the other cones, situated in the vicinity of the line *m*, *d*, will not be illuminated as far as their internal extremity by the rays from *d*, which penetrate less and less deeply into the neighbouring cones, in proportion as they become more remote from the line *m*, *d*. The nervous filament *m*, corresponding to the cone *h*, is consequently impressed with the ray *d'*; the other rays from *d*, being absorbed by the pigment investing the neighbouring cones, will of course produce no effect on any nervous filament placed out of the line *m*, *d*. The coloured ray *d'* is therefore perceived only by means of the filament *m*, on which latter alone it impinges. So also the

ray c', given out at the point c, will pass through the whole length of the cone g, and will affect only the corresponding nervous filament l; the ray b' traverses only the cone f, and is perceived only by means of the filament k; and the ray a', emitted at the point a, is perceived only by means of the filament i, after having passed through the cone e.

"The variously coloured rays given out from the points a, b, c, d, will thus produce in the interior of the eye a determinate figure corresponding to the luminous object without; and the same remarks will necessarily apply to any number of points situated between a, b, c, d.

"Each nervous filament conveys to the bulb of the optic nerve the impression of the rays which it has individually received; and as all the nervous filaments, at first insulated by the pigment, are at length united together in one common or continuous bulb or nervous expansion, the impression received by each filament is united to those of all the others in the bulb of the optic nerve; and so a common and continuous image is produced. Rays coming from one point of a remote object will, it is true, illuminate throughout more than a single cone, and then to each luminous point without, there will correspond in the interior of the eye, not exactly a single illuminated point, but rather a little circle of diffused or dispersed light, and in consequence an image of but little distinctness will be produced on the sentient retina; the distinctness of the image, of course, increasing in proportion as the object approaches the eye." For much more information on this interesting topic we refer the reader to Loudon's 'Mag. of Nat. Hist.,' vol. iv. p. 124 et seq.

HEARING.—That insects in their perfect stage possess the sense of hearing may be concluded from the sounds which they utter, or the noises which they make, evidently by way of signals to each other, and, indeed, experiments seem to prove that this sense, if not universal, is at least very general in this class of beings. The question is, in what part the organs are situated. In the higher crustacea, the organs of hearing are seated at the base of the larger antennæ, where a tympanic membrane may be seen stretched across a little pit with an elevated margin; see 3410, the head of a lobster: a, a, the auditory apparatus; b, b, the antennæ. Whether in insects the organs have their situation in the antennæ or not, is a point still at issue. In some moths Treviranus discovered a drum at the base of the antennæ, behind which were large nerves derived from those supplied to the antennæ. In other insects, where this drum cannot be detected, antennæ themselves may be susceptible of the impressions of sound. In proof that insects hear we may mention that Derham, who kept a male and female death-watch beetle (Anobium) in a box for about three weeks, could make them click whenever he pleased, merely by imitating their sound. This they produce by striking the woodwork with their head. Fig. 3411 represents a, the Anobium tesselatum; b, the Anobium striatum; c, the Anobium pertinax; all greatly magnified. It is supposed by some that the degree of hearing enjoyed by insects is in proportion to the length of the antennæ, and they instance the green grasshopper (Acrida viridissima) as an instance in point, and also a beetle, Acanthocinus ædilis, Fig. 3412, a, and a moth, Adela De Geerella, b and c, male and female.

TASTE.—It can hardly be doubted but that insects are endowed with the sense of taste; for we know that they give preference to certain kinds of food, and thus select the most agreeable aliment. Thus the caterpillar of the ringlet butterfly (Hipparchia Hyperanthus) prefers the annual poa grass (Poa annua), see Fig. 3413; and certain species have their exclusive parasites, of which one infests the marbled butterfly (Hipparchia Galathea), Fig. 3414, and feasts upon its juices.

It has been, indeed, objected, that the sense of taste must be very deficient, and even wanting, in bees, since they often collect poisonous honey, a fact noticed by Xenophon, who states that near Trebizonde, the soldiers who had partaken of the contents of some combs were rendered stupified or intoxicated. In this district, as was ascertained by Tournefort, poisonous honey is still prepared, evidently from the nectar of the Rose Laurel (Rhododendron Ponticum), Fig. 3415, or the Yellow Azalea, Fig. 3416, plants abounding in that country. In 1790, the honey collected near Philadelphia was found to be fatally deleterious, and was traced to the flowers of the Kalmia latifolia.

We do not, however, see how this indiscriminate selection of flowers by the bee can prove its deficiency of taste; for, be it observed, it is for itself and its progeny that it lays up honey, and not for man, who is really a plunderer; and if the honey be not injurious to the insects, they cannot have erred in their choice of blossoms.

Of the fondness of the fly and the wasp for sugar all must be perfectly aware, and the attacks of the latter on sugary fruits, such as the ripe greengage, are notorious.

SMELL.—The sense of smell is intimately connected with that of taste; but to what extent insects possess it, and in what organ is placed the appreciation of diffusible odours, is not very clear. Some, indeed, appear to possess it in a high degree, for that carrion-loving beetle, the Necrophorus Sepultor, see Fig. 3417, has been seen, while flying at the height of twenty feet from the ground, to descend suddenly, and creep under the dead body of a frog half dried up by the sun, and hidden amidst the grass. Some physiologists, indeed, suppose that this sense resides in the antennæ; or that the antennæ appreciate the scent of distant objects, and the palpi that of contiguous bodies.

Comparetti imagined that in the Lamellicorn beetles the sense of smell was seated in the extremity of the antennæ. But of this there is not a shadow of proof, nor, in truth, do we really know in what organ or organs the sense in question is placed.

As a proof of the possession of smell in insects, Mr. Rennie says that he has seen the painted lady (Cynthia cardui), a high-flying butterfly, descend from a considerable elevation upon the blossom of the Alpine bluebottle (Centaurea montana), the scent of which is far from powerful. (Fig. 3418.)

According to Huber the Snap-dragon (Antirrhinum majus) is attractive to bees, and we have often seen both the humble-bee and the hive-bee enter the flowers, resting on the lower lip of the blossom, while the tongue was insinuated between the upper lip and valve, and on being pushed forwards made way for the head to enter. (Fig. 3419.)

It is a very interesting sight to watch the humming-bird moth (Macraglossa Stellarum) hover round the flowers of the trumpet honeysuckle (Caprifolium sempervirens), and while poised on the wing insert its proboscis and suck up the luscious nectar. (Fig. 3420.)

Among the various proofs that insects are endowed with the sense of smell, has been adduced the fact of many species emitting offensive odours by way of protecting themselves from the attacks of others of their own class. As an instance in point we may allude to that beetle termed the bombardier (Brachinus crepitans), of which the chief enemy is a large beetle (Calosoma, inquisitor) the attacks of which it often baffles by the discharge of a sort of smoke, thus escaping from its surprised assailant. At Fig. 3421 a represents the bombardier; b, the calosoma. The smoke of another species of Brachinus is of a pungent odour, similar to that of nitric acid, and reddens white paper.

The Rove beetles (Staphinidæ), in addition to their powerful jaws and threatening attitudes, annoy their enemies by their offensive odour. Of these one example, the common rove-beetle (Goerius olens), Fig. 3422, is well known. The odour of the Silphidæ, which feed on carrion, and of the churchyard beetle (Blaps mortisaga), is extremely disgusting.

Among quadrupeds the skunk and various allied species discharge a secretion of most overpowering odour when attacked, and compel their enemies to flight: see vol. I. p. 218.

Huber, who tried various experiments relative to the effects of odour on bees, states that the mineral acids and volatile alkali produced a greater effect than turpentine, and that musk and camphor were both avoided. "On presenting," he says, "some musk to bees feeding before the entrance of their hive, they ceased and partially dispersed, but without precipitation or beating their wings. We sprinkled some powdered musk on a drop of honey, into which some bees thrust their suckers as if by stealth, for they kept back from it as far as possible; but although they often appeared to suck it, we did not perceive it to diminish in a quarter of an hour, long before which it would have disappeared had it not been mixed with musk. Pounded assafœtida, the odour of which is so disagreeable to us, upon being mixed with honey and put at the entrance of a hive did not seem to annoy the bees, for they greedily sucked all the honey, neither attempting to withdraw nor vibrating their wings, till they only left the particles of gum. Having remarked that bees going out to the fields and coming home turned aside in the air to avoid passing over a piece of camphor laid before the entrance of their hive, I tried the effect of bringing some camphor towards their mouths while their tongues were plunged into some honey placed on a card. All of them took flight, but after flying about for some time they ventured to alight near the honey. While they were tempted again to try it I threw some bits of camphor on the surface; they drew back a little, still keeping the tip of their tongues amidst the honey, and carefully avoided the camphor. One vibrated its wings as it fed, while some were less affected, and others not at all, but when I covered the honey entirely with camphor, they all flew instantly away. I had this card carried to my hives' while some honey was put on another clean card within reach of the bees. The latter was soon discovered, and the honey consumed in a few minutes, but an hour elapsed before a single bee came near the camphorated card, when at length two ventured to alight on it, and thrust their tongues into the edge of a drop of honey; others followed, and two hours after it was covered with them, and all the honey consumed, the camphor alone remaining; whence it was proved that the attraction of honey overcomes their repugnance to the smell of camphor." Huber also found by experiment that the odour of the poison of bees influenced individuals of the same species, exciting them very greatly, and throwing them into fits of violent rage: this is a remarkable circumstance, and we are utterly at a loss how to account for it.

TOUCH.—With respect to the sense of touch little need be said; no one who has watched a fly cleaning itself with its limbs can doubt of its possessing the faculty. In many instances, however, the chief seat of touch, or tact, seems to be in the antennæ and palpi, though in some beetles, as the musk beetle (Cerambyx odoratus), and the catch-weed beetle (Timarcha tenebricosa), the terminal portion of the foot is furnished, besides its claws, with soft cushions, or palms, which assist the insects in feeling the ground as they walk. Fig. 3423 represents, a, the musk-beetle; b, the catchweed-beetle.

The antennæ of insects, in which it is generally believed the sense of touch chiefly resides, are two in number, but various ad infinitum in shape, and the number of joints composing them. In many instances they differ in the sexes of the same species. They are always situated so as to be under the direction of the eyes, and are usually based in a circular pit or torulus, which receives the first joint, and in which it rotates. These organs are provided with nerves and muscular fibres, and are often clothed externally with fine down, hairs, or bristles. In some insects they are elegantly feathered, in others they are plume-tufted, in others clubbed, or with terminal lamelliform appendages. When the antennæ are in repose, they assume various positions. When they are remarkable for length they are turned back or to one side; in some of the predatory beetles and many others, they are received into a cavity or groove of the thorax; in other instances they are turned under the head. In the lamellicorn beetles, as the chaffer, their station is in a cavity behind the eye. In some aquatic species, as the Gyrinus, they are drawn into a cavity which is furnished with a little lid; this closes and protects them.

The motions of the antennæ when in action are as varied as their forms; in some, as the Ichneumon-flies, they are in perpetual vibration; other insects extend them, and constantly apply them to bodies adjacent. The lamellicorn beetles bring them forwards and expand the lamellæ as if to receive atmospheric impressions. Ants and bees appear to communicate to each other their wants, desires, plans, or discoveries, or to make inquiries by touching each other in various ways with these organs. The biarticulated thick and hollow antennæ of the Paussus sphærocerus, a beetle which feeds upon wood, are luminous at night, gleaming with pale effulgence.

That the antennæ are organs of high importance cannot for a moment be doubted, and it is probable that besides being endowed with the sense of touch, and having perhaps the organs of hearing at their base, they may be endowed with a sense of the nature of which, because we do not possess it, we have not the remotest idea.

Virgil, deceived probably by the similarity between the syrphus and the bee (see Fig. 3424: a, bee; b, syrphus), gives a full and particular account of the mode in which a swarm of bees may be produced from the carcass of a young bullock cruelly slaughtered; and no doubt his contemporaries believed in the infallibility of his direction. But that the syrphi, dipterous insects which he mistook for bees, proceed from eggs, deposited by a female or females, no one in the present day is so ignorant as to doubt. In fact we need scarcely say that insects are oviparous—some few are viviparous; that from the eggs are produced caterpillars, or larvæ, which, after changing their skin several times, assume a dormant state, and become pupæ, or chrysalises, and that from the pupa case emerges the perfect insect, to commence a new existence. Such is the general rule, except, as we have hinted, where the eggs are hatched in the body of the parent, or where the young are born in the pupa state, as in certain species of the order Diptera.

The eggs of insects are very variable in shape; most perhaps are oval or round; in some instances they are lenticular, in others somewhat conical; sometimes they are pedunculated. Many, when examined through a microscope, closely resemble the shelly cases of Echini, often called sea-eggs.

3420.—Humming-bird Moth and Honeysuckle.

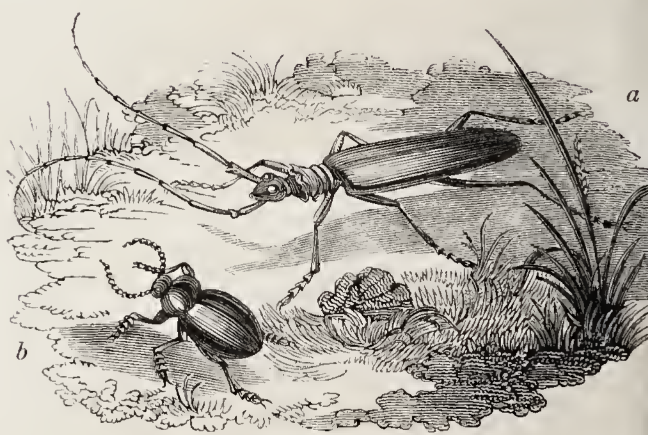
3416.—Yellow Azalea.

3413.—Ringlet Butterfly and Poa Grass.

3421.—Bombardier and Calosoma.

3414.—Marbled Butterfly.

3422.—Rove-Beetle.



3423.—Musk-Beetle and Catchweed-Beetle.

3417.—Necrophorus Sepultor and Frog.

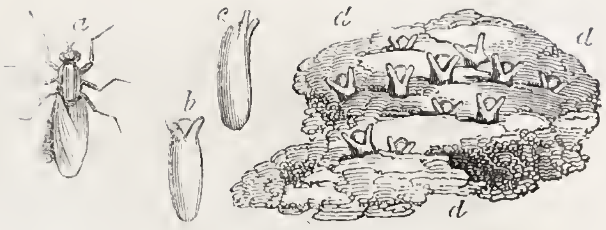
3415.—Rose-Laurel.

3418.—Painted Lady and Alpine Bluebottle.

3419.—Bees and Snap-dragon.

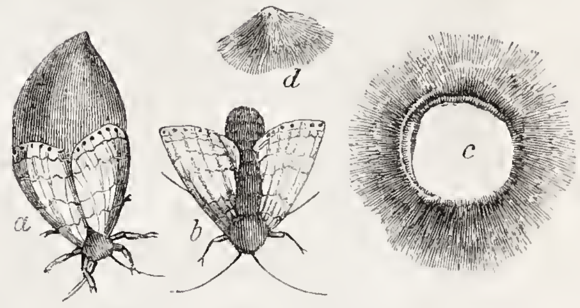
3439.—Gnats forming a Raft of Eggs.

3438.—Lackey-Moth.



3430.—Dung-Fly and Eggs.

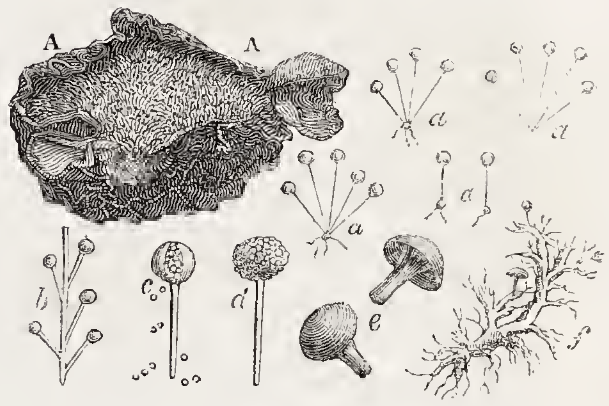
3435.—Eggs of Lackey-Moth.



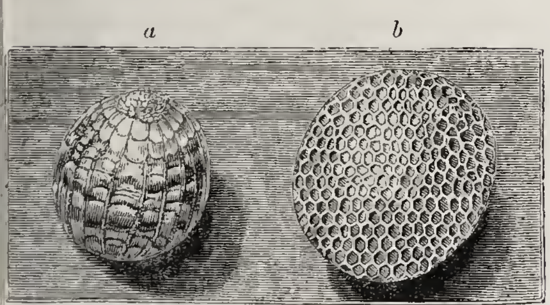
3437.—Female Gipsy-Moth, Eggs, Nest, &c.

3434.—Two Groups of Eggs of Rose-leaf Roller.

3424.—Bee and Syrphus.

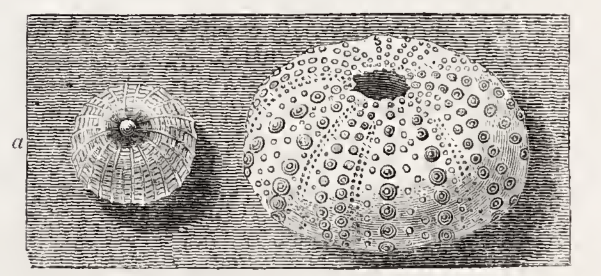


3432.—Apple and Pear Mould.

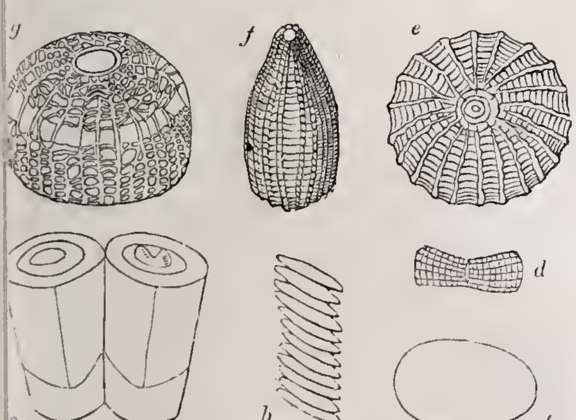


3429.—Egg of Meadow Brown Butterfly and of Brimstone-Moth.

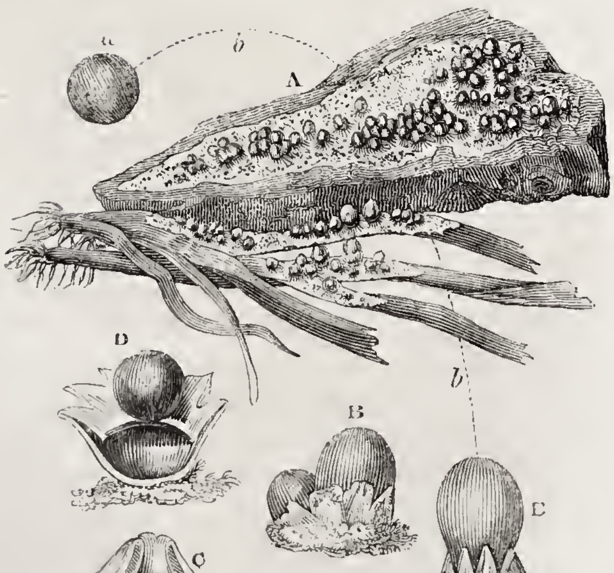
3431.—Lace-winged Fly and Eggs on Lilac.



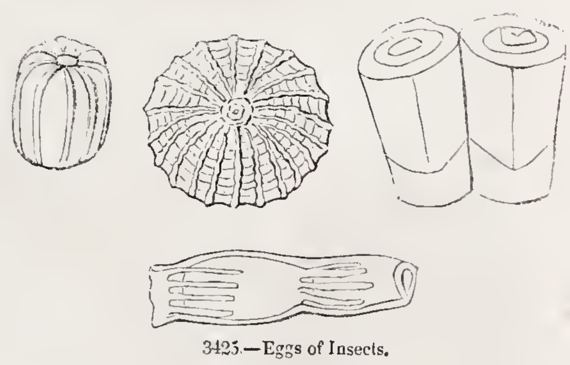
3428.—Egg of Angleshades Moth and Sea-Egg.



3427.—Eggs of Insects.



3433.—Seeds of Sphærobolus stellatus.



3425.—Eggs of Insects.

3436.—Eggs of unknown Moth.

3426.—Egg of Butterfly and of Moth.

The figures and appearance of these eggs will be better understood by reference to our examples than by mere verbal description.

Fig. 3425 represents the eggs of four different insects, all differing from each other in external characters—they are of course greatly magnified.

Fig. 3426 represents the egg of a butterfly, and of a moth, magnified.

Fig. 3427 represents the eggs of several species as they appear under a microscope: *a*, the egg of Geometra armillata; *b*, of an unknown aquatic insect; *c*, of the lackey-moth; *d*, of a caddis-fly (Phryganea atrata); *e*, of the red-underwing moth; *f*, of the cabbage-butterfly (Pontia Brassicæ); *g*, of the Clifton nonpareil-moth.

Fig. 3428 represents: *a*, the egg of the Angle-shades moth, compared with the case of an echinus (Clypeaster).

Fig. 3429 represents: *a*, the egg of the meadow brown butterfly; and *b*, the egg of the brimstone-moth.

Fig. 3430 represents: *a*, the dung-fly; *b* and *c*, the front and side views of its eggs, magnified; *d d*, several of these eggs deposited in cow-dung.

Fig. 3431 represents the pedunculated eggs of the lace-winged fly (Chrysopa reticulata), attached to a sprig of lilac. The mode in which these eggs are attached is very simple. The female fly fixes a minute drop of gluten to the branch, and drawing it out, as a spider does his line, to the requisite length, leaves the egg fixed securely on its summit. The design in this singular plan of operation is to secure the eggs from the attacks of the caterpillars, of lady-birds (Coccinellæ), and other insects, the footstalk being too smooth and slender for them to climb upon.

It is very common to hear of blighting winds, that is, of winds carrying myriads of the eggs of insects, and spreading them over gardens, orchards, and fields, which the caterpillars devastate, stripping the trees and bushes of their leaves. We doubt very much the correctness of this theory, which appears to have arisen from the supposed analogy between these eggs and the seeds of many plants, which are distributed by the wind, as those of the dandelion, and various mosses and mould-plants. See Fig. 3432, representing microscopic views of apple and pear mould: A A, part of a withered apple covered with mould; *a a*, *a a*, several of the individual mould-plants, highly magnified; *b*, a branched one; *c*, *d*, seed-vessels, one bursting and scattering its contents; *e*, one of a mushroom shape; *f*, a portion of pear-mould of a branched shape. Insects carefully deposit their eggs, and in seasons when myriads of a certain species swarm in gardens, devouring the leaves of trees, the eggs have been deposited in the spot where the spoilers are at work, but have been unnoticed. Many plants project their seed to a distance, as the sweet pea, and still more so the minute fungus Sphærobolus stellatus, represented at Fig. 3433: A, the natural size; B, magnified; C, a sectional view, with the seed just previous to projection; D, the seed in the act of projection; E, a plant immediately after projection; *a*, the seed; *b b*, a line indicating its course.

Various insects have been observed to project their eggs to some distance, and an analogy has been supposed to exist in this respect between them and these plants. But we believe that it is only under an influence of alarm, and when caught, that this projection takes place: this is the case with the crane-fly when captured, and also of another fly, called, by the Abbé Preaux, Mouche Baliste—"insecte à quatre ailes qui lance ses œufs à diverses reprises, et comme par un ressort lorsqu'on le saisit."

All insects deposit their eggs upon or near the substances which are to furnish the future caterpillars with food. Consequently situations chosen, and the mode in which their safety is secured, are almost as diversified as the species are numerous. Some insects deposit their eggs on the leaves of plants, some glue them to the bark, others lay them on putrescent animal or vegetable substances, others leave them in the water, and others prepare for them artificial receptacles; the living bodies of other animals, and the substance of plants, afford a nidus for the eggs of many.

The rose-leaf roller (Logotænia rosana) deposits her eggs in oval groups, covered with a cement, either upon the branches of the rose-tree or upon some smooth object adjacent. Each group contains about fifty eggs; the caterpillar appears in the spring, and is well known as the "worm i' th' bud;" it mines into the yet unfolded blossom, where it becomes very fat, and ultimately rolls up the rose-leaf, forming a tent or dwelling in which to undergo its transformation. Fig. 3434 shows two groups of eggs of this species on a pane of glass.

The lackey-moth (Clisiocampa neustria) glues her eggs by means of a strong and hard cement to the twigs of bushes, arranging them in an annular manner, so that they form a ring or belt round the twig (see Fig. 3435). Another species of moth, not ascertained, arranges her eggs in an elegant spiral manner round a twig, covering them with a coat of fine short down (see Fig. 3436).

Another species, the gipsy-moth (Hypogymna dispar), like the rabbit and eider-duck, strips the down from off the hinder parts of her own body, in order to make a soft envelope for her eggs, in the form of a cone. Placing herself with the head downwards, on the trunk of an oak or elm, she first arranges a little bed of this down, into which she thrusts an egg; this is covered with gluten, which not only secures a covering of the soft material, but renders the egg adherent to the bark of the tree. Proceeding in the same manner, she continues for several hours adding to the mass, and then rests, returning the next day to her labours. The work is then completed, and the whole is covered externally with a thatch of hairs, arranged so as to throw off the winter rains.

Fig. 3437 shows: *a*, the female gipsy-moth, one-third of the natural size, just finishing her group of eggs; *b*, a female with the body covered with down; *c*, a circle of eggs covered with hair; *d*, a conical mound of eggs covered up with hair.

Fig. 3438 represents the lackey-moth in all its stages: *a*, the belt of eggs; *b*, the caterpillar; *c*, the pupa in its cocoon, within a folded leaf; *d*, the moth.

Among the insects which entrust their eggs to the water we may notice the gnat (Culex pipiens), her operations being remarkably curious and interesting. The larva of the gnat is aquatic, and abounds during the summer in all stagnant waters; but were the eggs to be submerged, their vitality would infallibly be destroyed. The gnat, therefore, in order to keep them afloat, has recourse, instinct-guided, to a wonderful plan. She forms them into a raft, which floats, exposed to the action of the sun and air, essential to the development of the larvæ.

At the time of laying her eggs the female gnat rests upon a twig or stone, her body being level with the surface of the water, which it touches. Extending her hind limbs, and using them with great adroitness, she proceeds to glue egg after egg together, fixing them side by side, to the number of two or three hundred. In this manner she forms a long concave raft, pointed at each end, and which is remarkable for buoyancy and the property of throwing off the water. Each individual egg is of a compress oval form, pointed above, and covered with a glutinous fluid. The under apex is valvular, a lid opening for the exit of the larva into the water, which takes place in the course of a few days.

Fig. 3439 represents two gnats forming their raft of eggs: *a* represents the commencement of the raft; *b*, the raft about two-thirds completed; *c*, a perfect boat resting on the surface of the water.

Fig. 3440 is a magnified representation of a raft of gnats' eggs.

The eggs of the gnat are not singular in having a valve or lid for the exit of the larva, which opens by being pushed. The eggs of those disgusting parasites, the pediculus humanus, and the nirmus, which infests the neck-feathers of the golden pheasant, are valvular, as is also the egg of the field-bug, Pentatoma (see Fig. 3441): *a*, the egg of the Pediculus humanus; *b*, egg of Pentatoma; *c*, the ribbed egg of a species of moth, which, after the escape of the caterpillar, exhibits an opening, the ribs having expanded for its exit.

A common species of moth, the vapourer (Orgygia antiqua), of which the female has only the mere rudiments of wings, and is of course incapable of flight, or indeed of moving far from the spot in which her last metamorphosis took place, has recourse to an admirable expedient for preserving her eggs through the winter. She fixes them on the substance of the silken cocoon from which she has herself emerged, and which is always in some snug and sheltered situation. "Thus," says Swammerdam, "like a prudent housewife, she never leaves her habitation." Her existence however is brief, for, the great object of her being accomplished, she soon perishes.

Fig. 3442 shows the wingless female and the male of the vapourer, with the eggs upon the cocoon from which the female has issued.

The eggs of this moth, as we have said, and of many others, have to pass the winter, and by a wise provision they are capable of enduring, without loss of vitality, a far greater degree of cold than they are ever naturally exposed to, even during the most severe winters.

In the year 1709, when Fahrenheit's thermometer fell to 1°, and animals and plants suffered most extensively, yet, as Boerhaave observes, this intense severity did not destroy the eggs of insects, not even those exposed to its influence in the open fields, on the naked earth, or the branches of trees. When the spring had tempered the air, these eggs produced, as they usually did after the mildest winters. During December, 1788, the cold was in France even more intense, yet the eggs of insects were not destroyed. Spallanzani, relating his experiments on the eggs of insects, says, "I have exposed eggs to a more rigorous trial than the winter of 1709. Those of several insects, and among them the silk-worm moth, the elm butterfly, were enclosed in a glass vessel, and buried five hours in a mixture of ice and rock-salt; the thermometer fell 6° below zero. In the middle of the following spring, however, caterpillars came from all the eggs, and at the same time as those that had suffered no extraordinary cold. In the following year I submitted them to an experiment still more hazardous. A mixture of ice and nitrate of ammonia reduced the thermometer 22° below zero, that is, 23° lower than the cold of 1709. They were not injured, as I had evident proof by their being hatched." In these instances the eggs remain unfrozen, resisting, by a vital law, little understood, the effects of cold, which would have infallibly destroyed either the caterpillars or perfect insects. This does not only apply to the eggs of insects; but of birds also, except that those of the latter are not capable of enduring so low a temperature as those of the former: yet the resistance of the vital principle to the influence of cold is considerable, but when that principle is destroyed the cold easily operates. The celebrated John Hunter found that he could freeze an egg at the cold of zero, and that after thawing it, its vitality being destroyed, it would freeze when exposed to the same degree of cold sooner by seven and a half minutes. A new-laid egg took an hour to freeze in 15° and 17°, but when thawed it froze in 25° in half the time. To suppose, then, that rigorous winters destroy the eggs of insects, and thereby diminish their numbers, is fallacious; on the contrary, it often happens that after a severe season they are more than ordinarily numerous, perhaps because the cold has affected the beings which feed upon them, either destroying them, rendering them torpid, or driving them to more temperate quarters.

With respect to the effects of heat, the resistance of the eggs of insects is almost as great as in the instance of cold. Spallanzani found that, though silk-worms perished when exposed to a temperature of 108° of Fahrenheit, the eggs did not entirely cease to be fertile till the temperature amounted to 141°. In the case of the blow-fly, a great many of the eggs produced maggots at 124°, but at 135° and 138° most were destroyed, and all at 140°.

Many insects make elaborate structures for protecting their eggs and brood, over which they watch with assiduous care, supplying the wants of the latter with unceasing industry. We may mention the bee, the wasp, and the ant. There are, however, other examples. The termite builds large and solid structures, in which she deposits her countless eggs; these the labouring community take under their charge, and remove from one compartment to another, as the weather may render necessary. Fig. 3443 shows the cell of a queen of the Termites bellicosus broken open in front; the labourers are seen surrounding the queen, and carrying off her eggs for safety. To these insects we shall again have to advert.

There are various species of insects, called mason-wasps, mason-bees, mining-bees, &c., which, unlike the hive-bees and common wasps, are solitary, but which form receptacles for their eggs, requiring no little labour and perseverance. That delicate little bird the sand-martin (Hirundo riparia) bores deep galleries in the face of sandy cliffs, with its short but strong bill, for the purpose of nidification; and in some of these insects the same plan is carried into execution. A common species of solitary mason-wasp (Odynerus), see Fig. 3444, is capable of making its way into the substance of a brick, by means of its powerful jaws; it detaches fragment after fragment, severing pieces of the size of a mustard-seed, with which the insect flies away, carrying them to a distance from the scene of her labours, lest they should indicate to the sharp eyes of the ichneumon-fly or cuckoo-fly (Tachina larvarum) the "whereabouts" of her cell. Fig. 3445 shows the mandibles of the mason-wasp greatly magnified. Mr. Rennie informs us that he saw one of these wasps busy in excavating a hole in one of the hard bricks of the wall of a house at Lee, in Kent, and had already made considerable advance in her labours with her strong mandibles; she severed fragment after fragment, carrying each away, and in two days finished her cell, the entrance of which just admitted her body. When the excavation was completed, it took two days more to line it with a coating of clay, to deposit the eggs, and, as he supposes, imprison a few paralyzed spiders or caterpillars for the larvæ to feed upon. The entrance was then closed up with a thick layer of clay. In November the observer hewed away the brick around the nest, and found the excavation to be rather less than an inch in depth: it appeared, moreover, that notwithstanding all her care, the wasp had not been able to prevent the entrance of the cuckoo-fly, Tachina (see Fig. 3446), which had deposited an egg there, and the grub hatched from it had devoured one of the wasp-

grubs, and then enclosed itself in a cocoon, as did also the undevoured wasp-grub, both awaiting the return of summer to emerge perfect insects, and take the place of their parents. Fig. 3447 represents the mason-wasp's nest in question: *a*, the cocoon of the cuckoo-fly; *b*, that of the wasp.

Another species of mason-wasp (Odynerus murarius), Fig. 3448, constructs singular burrows in hard sand-banks, to the extent of two or three inches, and that with great rapidity: but this is not all; with the particles detached during the process of excavation, she builds a tower encircling the mouth of the burrow, but very slightly, as it is only a temporary structure, intended as a pile of materials for finishing the interior of the cell, or, according to Réaumur, to serve as a protection from the attack of the ichneumon-fly or her progeny. The wasp stores her cell with living caterpillars, fixed together in a spiral column, as food for the larva, which, after exclusion from the egg, has nothing to do but to eat, from its birth to its transformation. Fig. 3449 shows a group of these nests, about half the natural size: *a*, the tower of the cell; *b*, the entrance after the tower is removed; *c*, the cell; *d*, the cell, with a roll of caterpillars prepared for the larvæ.

Not less remarkable are the solitary mason-bees with respect to the cells they prepare for the reception of the eggs, the materials of which vary in the different species. One species, the Anthophora retusa (Fig. 3450), has been observed to build its cells of lime and coarse sand, in the fissure of brick-work or other convenient places. One of these structures was observed, by Mr. Rennie, in Greenwich Park: externally there appeared an irregular cake of mud, as if a portion of road-stuff had been plastered on the wall: in this was a circular hole, leading to a cell, then empty; but, on removing the cake of mud, another cell was found, and in it a living bee, just emerged from the pupa state, and ready to escape. Fig. 3451 shows the cake of mud, interspersed with minute pebbles; Fig. 3452, the cells of this species, one-third the natural size. Another species, the Megachile muraria, a native of the Continent, constructs cells of fine sand, kneaded with their mandibles into a sort of mortar by means of a glutinous saliva, and not unmixed with garden-mould. Another mason-bee, the Osmia bicornis, kneads up clay, tempering it to a proper consistence, with which to construct her egg-cells. Fig. 3453 represents, A and B, the cells of Osmia bicornis, between bricks; and C, those of Megachile muraria, in the fluting of an old pilaster; about half the natural size. Réaumur describes another kind of mason-bee, which selects a small cavity in a stone, in which she forms her nest of garden-mould, covering it up with mortar of the same material (see Fig. 3454). These bees place in their cells balls of pollen for the nutriment of the grub when hatched.

We may here notice the little solitary mining-bees, which bore pits in sunny banks, to the depth of six or eight inches, terminating in a little chamber almost at right angles with the entrance. Both the tubular pit and chamber are very smooth, and in the chamber is deposited an egg, with a ball of pollen for the grub: one of these chambers is represented at Fig. 3455. We may here observe, that in all these instances the female is the labourer—there is no special community of workers—and the males are idle. Another group of solitary bees are termed carpenter-bees, from the circumstance of their working in wood, especially such as is softened by exposure to weather, and consequently posts, palings, and outdoor woodwork are the ordinary objects of their selection. They not only bore galleries in the wood, but avail themselves of any suitable hole or crevice, and often take possession of old nests and repair them. The labour of excavation is undertaken solely by the female; and, as in the case of the mason-wasp, she carefully removes to a distance all the chips which have been chiselled off by her horny jaws. When, by dint of unremitting industry, she has sunk a shaft of sufficient depth, she deposits at the bottom an egg and a ball of pollen; and then, having prepared some clay, she forms a partition above, at a proper distance, and on this deposits another egg and ball of pollen—making another partition with clay, and so on till the shaft or tunnel is divided into six or eight compartments, each with its egg and pollen for the future grub: the task being at length completed, she covers the external entrance, and so blocks all safely in. The wood is not lined with any material, but is worked quite smooth and even. Fig 3455 represents, A and B, a section of the cells of the carpenter-bee, the former with larvæ, the latter empty.

Réaumur describes a species, the violet carpenter-bee (Xylocopa violacea), a native of the Continent, but not of our island, which, he says, usually selects upright posts or pieces of wood for its cells. It first bores obliquely for about an inch, and then, changing the line of direction, works perpendicularly to the depth of twelve or fifteen inches; the tunnel or shaft being half an inch in diameter. Sometimes a single bee makes three or four of these galleries—a task requiring several weeks of incessant labour. This part of the work effected, she deposits her eggs, each in a separate cell, one cell above another, placing with each a store of pollen mixed with honey for the use of the future larva; and the quantity, by the unerring teaching of instinct, is duly proportioned to its wants. The partition of the cells, or stories, are not formed of clay or earth, but of the saw-dust which has resulted from her previous operations, and which, instead of throwing away, she collected into a store-heap for use, at a short distance from the habitation upon which she was at work; this she kneads up with her mandibles into a sort of paste, and applying it, bit by bit, to the wall of the tunnel, forms a ring, to which she keeps adding till a circular plate is produced about the thickness of a half-crown piece, and of considerable hardness. When examined, this plate is found to consist of concentric circles, as in the transverse section of the bole of a tree—the result of her annular mode of filling up from the circumference to the centre of the plate. As the whole of this process occupies several weeks, and as the first eggs deposited will necessarily be hatched before the others, and the last transformation from the pupa to the perfect insect also first effected, the bee provides against this contingency; and, in order that her offspring may not suffer unnecessary imprisonment, she makes a lateral opening at the bottom of these lowest chambers, barricading them with sawdust-paste, which the mandibles of the young bees are capable of breaking up, though as yet unequal to the task of gnawing the more solid wood itself.

It is impossible, in contemplating the labours of these insect architects, not to be struck with the proofs of wonderful instinct which they display. The natural instruments for carrying on the impulses of that instinct are in just accordance—the knowledge of the plan to be pursued is innate—and hence, without a pattern and without previous experience, the bee effects her purpose, and fulfils the task to which a mysterious principle impels her, and in the performance of which she was, by the same principle, unconsciously guided.

Fig. 3456 represents, A, part of a post tunnelled in several places by the violet carpenter-bee; the wood is split, and shows the cells and passages by which they are approached; B, a portion of the post, half the natural size; C, a piece of thin stick bored by the carpenter-bee, and split to show the nests; D, one of the partition plates, showing its concentric rings; E, the carpenter-bee (Xylocopa violacea); F, mandibles of the carpenter-bee, greatly magnified—*a*, the upper side; *b*, the lower side.

There are solitary carpenter-wasps (Eumenes) as well as carpenter-bees, which bore deep excavations, or rather mines, in soft or decaying timbers, but with much less regularity and neatness than the latter. The partitions are formed by the sawdust produced during the boring process, but are comparatively irregular, and the whole has a more disorderly appearance. The provision stored up with the eggs for the larvæ consists of flies and gnats huddled in a heap together; and it is remarkable that when the larvæ spin a cocoon, in which to assume the pupa condition, they interweave with the silk, sawdust and the wings of the insects whose bodies they have devoured.

Fig. 3457 represents, A and B, sections of old wooden posts with the cells of the carpenter-wasp. In A the young are feeding on their insect stores; in B the cells contain cocoons; C, a carpenter-wasp, of the natural size; D, the cocoon of the pupa of a carpenter-wasp, in which sawdust and the wings of insects is mingled with the silk.

There is a group of solitary bees, called by some naturalists "upholsterers, or leaf-cutting bees," which line their egg-cells with portions of the leaves of shrubs or the petals of flowers, or the down of plants or trees. One species, the poppy-bee (Osmia papaveris), selects the delicate petals of the scarlet poppy as tapestry for her cells. This bee makes a cell of about three inches deep, and in shape like a Florence flask, in banks of firm earth or trodden pathways; and, this accomplished, she makes her way to the scarlet poppies, so common in our corn-fields: delicate as are the petals, which it is almost impossible to lay down smoothly and without wrinkling upon the most nicely glazed paper, yet she manages to cut off small portions of an oval shape, which she carries between her legs to her cell, and most neatly and accurately spreads over the bottom, where she commences by arranging three or four layers of this brilliant material; she then lines the sides with two or three layers, which are carried up quite to the external entrance. Having thus hung her cell with scarlet tapestry, she next fills it to the depth of half an inch with the pollen of flowers mixed with honey, and on this store of provision for the future larva she carefully deposits an egg; over this she folds down the scarlet tapestry of poppy-petals, so as to embower the egg, and then fills up the entrance and narrow tunnel leading to the cell with earth, and leaves it concealed from the eye of every prying enemy.

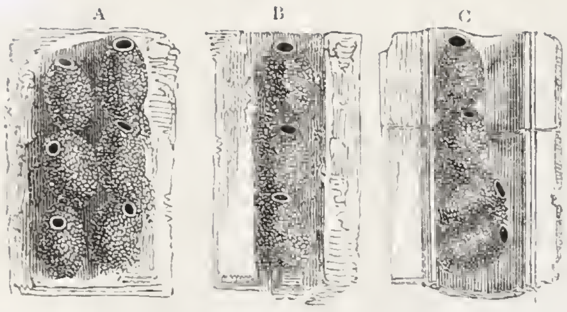
Another species, the Anthidium manicatum, which is said seldom or never to excavate a cell herself, but to appropriate any cavity or hole in timber or decayed trees suitable to her purpose, lines the selected chamber with down—this she assiduously collects from various plants, as the rose campion, the quince, the cat's-ear, &c., stripping a leaf or branch, or rather, as White of Selborne says, shaving it bare, with the utmost address. When she has obtained a bundle of this down almost equalling her body in bulk, away she flies with it to her nest, holding it securely between the fore limbs and the chin. This bundle is not a loose mass, but a roll of compacted or felted down, in the form of a riband; and it is with this that the cells are formed, and, according to Latreille, she deposits in them her eggs and a store of paste made of pollen and honey. It appears that the down is also smeared with pollen and honey on the inside, perhaps to keep it in form. There are, however, some points in the structure of these cells not well understood.

Another species, common in Europe generally, called the Rose-leaf cutter (Megachile centuncularis), has been long celebrated for its ingenious habits. She makes a burrow in the earth, generally selecting a pathway or some spot where the ground is solid, sometimes in decayed wood, to the depth of six or ten inches. In this she constructs a series of cells made generally with portions of the leaves of the rose-tree, which she cuts out on purpose, and secures together. The cells are in form like thimbles, and the bottom of each is inserted into the mouth of the other in regular succession. Though the leaf of the rose-tree is most in request, still that of the mountain ash and other trees is not rejected: but from whatever she takes her materials, her method is the same; clinging to the lower edge of the leaf, which she holds between her limbs, she neatly cuts out a circular piece with her mandibles, keeping, as she proceeds, the cut portion between her legs, so as not to impede her in her progress, and at the same time clinging to it. As soon as she has cut so far that her weight might tear off the piece, she poises herself on her wings, completes the separation, and flies off to her gallery. During her flight she holds this portion of leaf in a bent position, perpendicular to her body, and arriving home fits it to the interior of the excavation, without glue or paste, trusting to the elasticity which the leaf acquires in drying to retain its position. Each cell is made up of ten or twelve of these pieces, and the serrated edge of the leaf is always placed undermost. In spreading the layers no joining is placed opposite to a joining, but the piece is so bent and applied, that its centre is opposite the joining of two others, which it thus strengthens and secures. In the cell, thus composed of bent layers, is deposited a store of honey and pollen, which, being chiefly obtained from the flowers of the thistle, is of a beautiful roseate tint. On this she deposits an egg, and covers in the opening with three pieces of leaf, forming a circle as true as if lined out by a pair of compasses. Another cell is now added, and replenished in the same way, and so on till the gallery is filled, when the entrance is stopped up and all left in security. When, during her operations, any accident may have deranged the structure or progress, this industrious bee sets to work to restore all to rights, persevering with the utmost patience till her aim is accomplished. Fig. 3458 exhibits some rose-leaves cut by this bee; two bees at work; and a gallery laid open, exposing the thimble-shaped nests, one fitted into another.

Such, then, are the varied and ingenious modes adopted by these solitary bees and wasps for the concealment and protection of their eggs and future larvæ. Hereafter we shall have to notice the proceedings of other wasps and bees, which have been from ancient days regarded with the highest interest, and in modern days studied by the most celebrated philosophers.

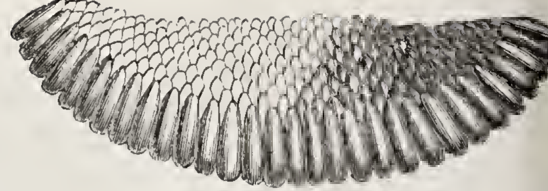
Let us, however, now advance to some other insects, and observe the mode in which they secure their eggs and provide for the larvæ.

It may appear to be a strange thing that the female should perish in the necessary task of securing the eggs she has deposited; but this occurs in the case of many of the Coccidæ, or Gallinsecta of Latreille, and especially in the Lac Insect (Coccus lacca), from which the valuable product called lac is obtained, and for which it is reared in plantations of a peculiar kind of fig, as the Ficus religiosa and the Ficus Indica; it feeds also upon the Butea frondosa and Rhamnus Jujuba. It covers the trees in countless myriads, but all are soon destined to perish. When the females, according to the statement of Kirby and Spence, "have fixed themselves to a part of the branch of the trees on which they feed, a pellucid and glutinous substance begins to exude

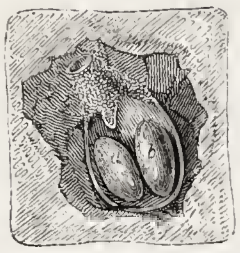


3153.—Cells of Mason Bees.

3456.—Cells of Carpenter-Bee in Wood.

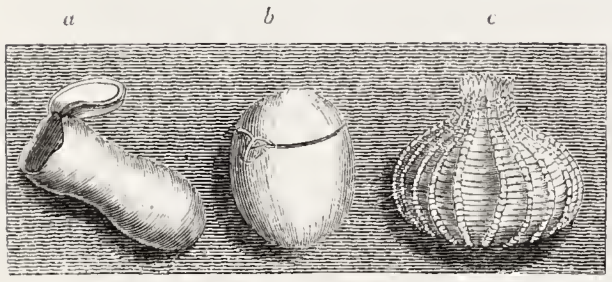


3440.—Raft of Gnats' Eggs

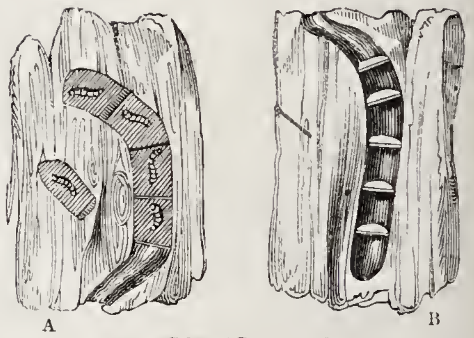


3447.—Nest of Mason-Wasp.

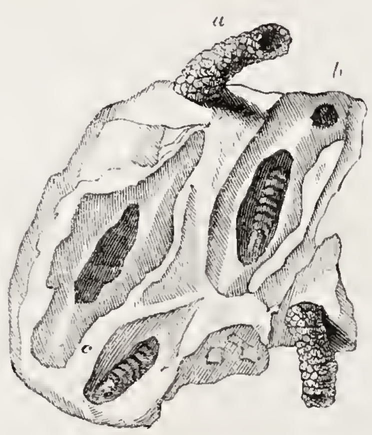
3454.—Mason-Bee and Cell.



3441.—Valvular Eggs.



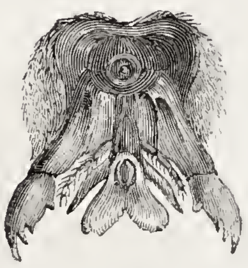
3455.—Cells of Carpenter-Bee.



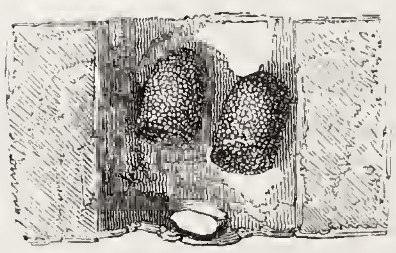
3449.—Nests of Mason Wasps.

3446.—Cuckoo-Fly.

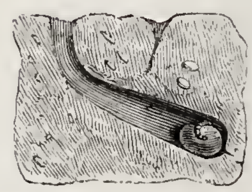
3450.—Solitary Mason-Bee.



3445.—Mandibles of Mason-Wasp.



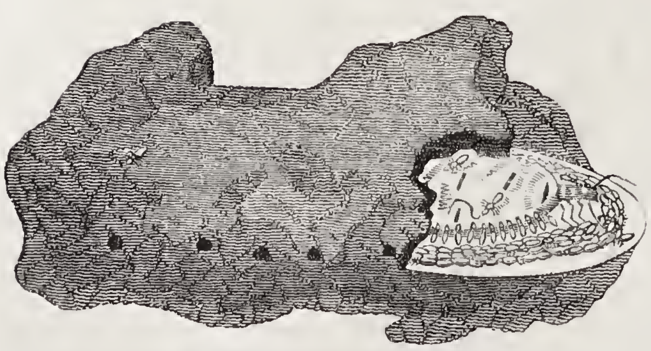
3452.—Cells of Mason-Bee.



3455.—Cell of Carpenter-Bee.

3448.—Solitary Mason Wasp.

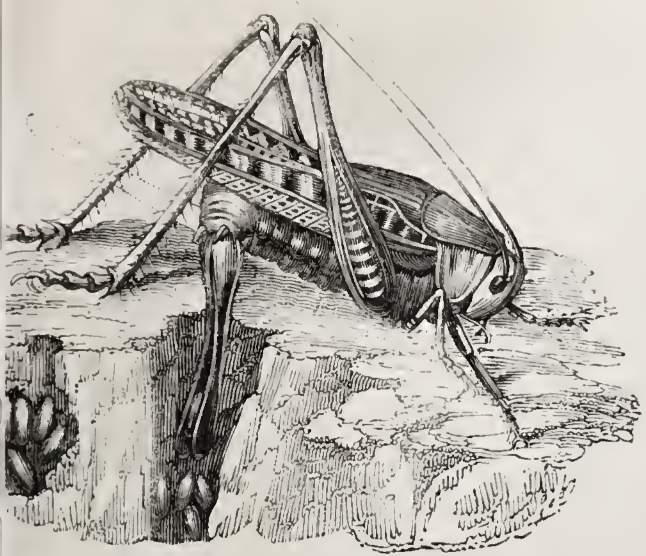
3444.—Solitary Mason-Wasp.



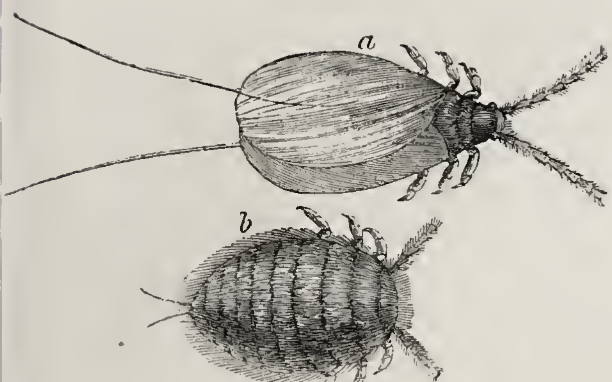
3443.—Cell of Queen of Termites.

3451.—Exterior of Mason-Bee's Nest.

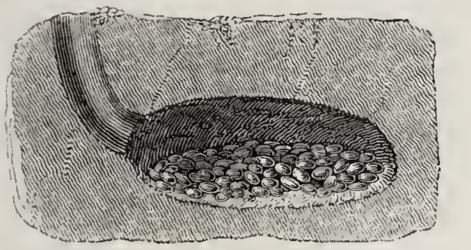
3442.—Vapourer-Moth, and Eggs



3463.—Spotted Grasshopper and Eggs.

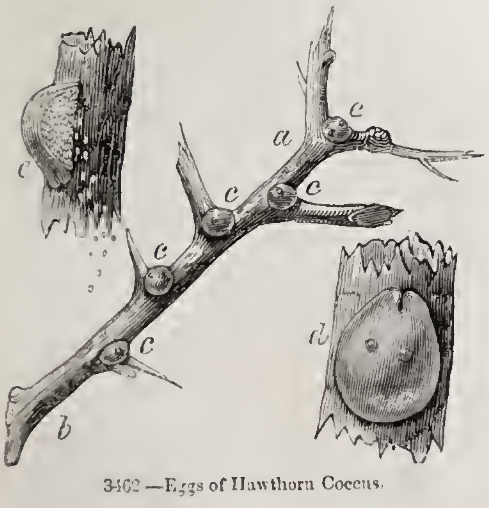


3460.—Cochineal Insects.

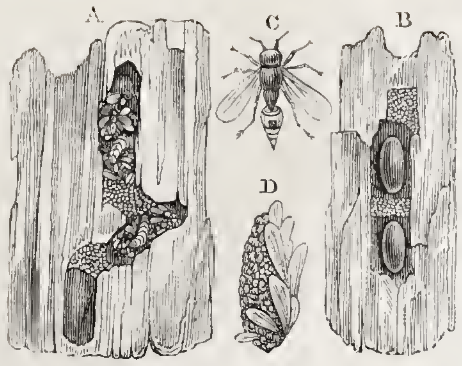


3466.—Nest of Mole-Cricket.

3465.—Mole Cricket.



3462.—Eggs of Hawthorn Coccus.

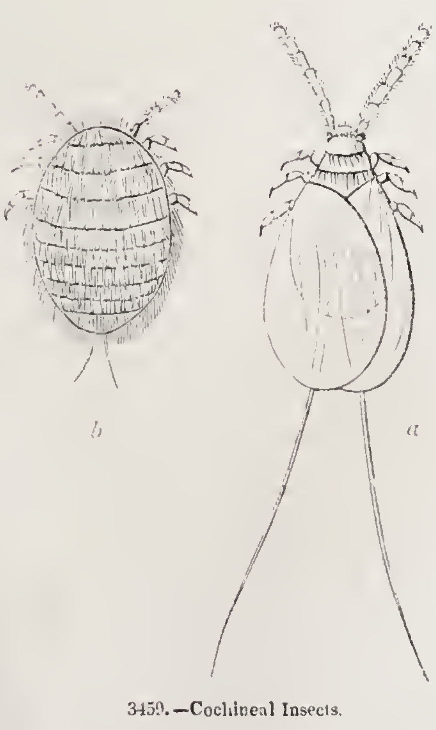


3457.—Cells of Carpenter-Wasp.

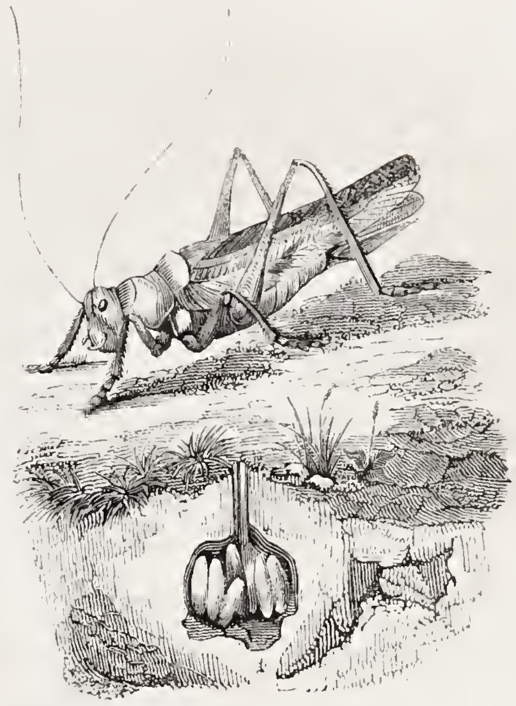
3471.—Hessian Fly and Markwick Fly.

3470.—Female Wheat-Fly.

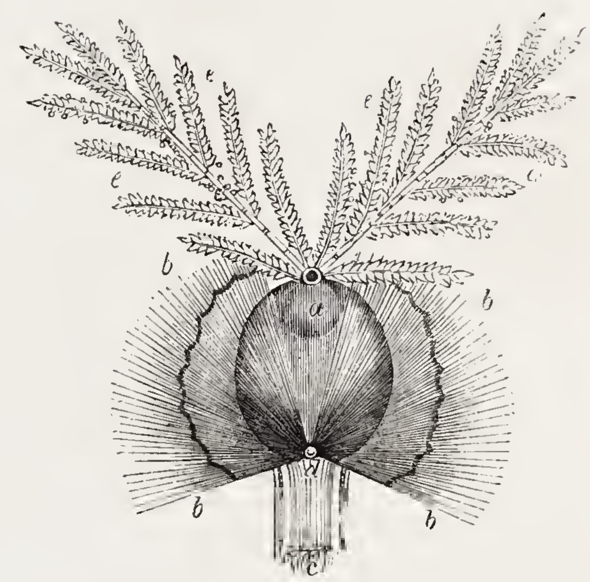
3467.—Ovipositor and Eggs of Crane-Fly.



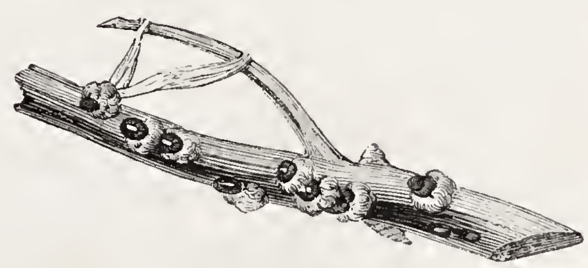
3459.—Cochineal Insects.



3464.—Greenfield-Cricket.



3469.—Germination of a Grain of Wheat



3461.—Eggs of Cochineal.

3458.—Rose-cutter Bee, Leaves, and Nest.

from the margins of the body, and in the end covers the whole insect with a cell of this substance, which, when hardened by exposure to the air, becomes *lac*. So numerous are these insects and so closely crowded together, that they often entirely cover a branch, and the groups take different shapes, as square, hexagon, &c., according to the space left round the insect which first began to form its cell; under these cells the females deposit their eggs, which after a certain period are hatched, and the young ones eat their way out. Though indisputably an animal secretion, many of the properties of lac are not very different from the juices of the trees on which the insect feeds, and which therefore would seem to undergo but little alteration." It may be added that the parent, after depositing her eggs, becomes glued to the spot and dies, covering the germs of her progeny. Lac is an important export from India, and is much used in this country in the composition of varnishes, japanning, sealing-wax, &c. It is called stick-lac when unseparated from the twigs on which it adheres; seed-lac when separated and pounded, the colouring-matter being extracted by water; and shell-lac when strained and allowed to harden in the form of thin flakes. Its colouring-matter is termed lac-lake, and a still superior preparation is known as lac-dye, and used as a dye either conjointly with cochineal or by itself.

The Cochineal (Coccus cacti), like the rest of this tribe, is closely allied to the Aphides, and feeds on the succulent shoots of a species of fig, called, in Mexico, nopal, and of which plantations are made for the sake of the insect product. According to Kirby and Spence, the cochineal is "chiefly cultivated in the Intendency of Oaxaca: and some plantations contain sixty thousand nopals in lines, each being kept about four feet high, for more easy access in collecting the dye. The cultivators prefer the more prickly varieties of the plant, as affording protection to the cochineal from insects, to prevent which from depositing their eggs in the flower or fruit, both are carefully cut off. The greatest quantity however of cochineal employed in commerce is produced in small plantations belonging to Indians of extreme poverty, called Nopaleros. They plant their nopaleries in cleared ground in the slopes of mountains and ravines, two or three leagues distant from the villages, and when properly cleaned the plants are in a condition to maintain the cochineal in the third year." Three gatherings of the insect take place usually in the course of the year; they are brushed off the twigs by means of squirrels' tails, or similar instruments, and are killed by exposure to the heat either of the sun or of ovens. It has been calculated that the annual consumption of cochineal, or the dried insect, amounts to about 750 bags, that is 150,000 pounds, worth about 370,000*l.* Our readers will, we trust, pardon this digression respecting the Coccus cacti, of which Figs. 3459 and 3460 give the representation: *a*, the winged male; *b*, the wingless female (magnified). Fig. 3461 exhibits the eggs of a species of coccus, invested with the down, which appears to be either secreted by the parent from pores in the skin, or excluded with them. Over each group of eggs is the body of the parent, glued fast and withered. They appear on the bark like so many nodes or excrescences, and might be easily mistaken for vegetable galls.

A species of coccus in our island infests the hawthorn and other trees, and places its group of eggs in oval cells at the divarication of the twigs or spines. These eggs are orange-coloured, and covered by the skin of the parent dried and shrivelled, and which is glued tightly over them. There are also several other species, some to be found on the hawthorn, others on the vine, on currant-bushes, &c. The eggs constitute a source of supply in winter to the titmouse, the hedge-sparrow, and the golden-crested wren.

Fig. 3462 represents the eggs of the Hawthorn coccus covered by the dead body of the parent: *a*, *b*, *c*, the groups of eggs; *d*, one of the cells magnified; *e*, a section showing the eggs within.

We may now pass to insects which deposit their eggs either in cavities on the ground, in the substance of plants, or of animal bodies, and for this purpose are provided with a special instrument, variously modified, termed the ovipositor.

It is by means of a stout and powerful ovipositor that the field-crickets, grasshoppers, and locusts bury their eggs in the earth, where the larvæ, when hatched, find, in the roots of grasses and herbage, abundant food. The ovipositor of these insects is straight, and consists of two upper and four lower blades, which together form a very efficient instrument; this inserted into the ground conveys the eggs safely to their destination. Fig. 3463 represents the spotted grasshopper of Europe (Tettigonia verrucivora) in the act of depositing its eggs. The dotted line shows the ordinary position of the ovipositor.

Fig. 3464 shows the eggs of the green grasshopper, Tettigonia viridissima (Acrida viridissima). The insect's ovipositor is in the ordinary position. We need not say that these ovipositors are not present in the stridulous males.

An allied insect, the mole-cricket (Grillotalpa vulgaris), deposits her eggs in a different method. This insect mole is well known in some parts of England, and commits in lawns, gardens, and fields no little havock; it bores into the earth, excavating long galleries, in which it lives; its fore-limbs are admirably adapted for the laborious operations it carries on, being short, thick, and palmated at the termination; their muscular power is enormous, and their action in shovelling the earth is the same as in its mammal representative; and they have, moreover, the same oblique tournure. These insects appear to live in small societies; and we have seen a patch of moist ground in which their burrows were very numerous. This insect has been said to devour the roots of herbage—and certainly it cuts them asunder, but this it apparently does, in order to carry out its superficial galleries, while in pursuit of worms, ants, and other underground insects. The nest of the mole-cricket, in which the female deposits her eggs, is a smooth excavation at no great distance underground from the surface. Latreille says that she lays her eggs in June or July; but according to Gilbert White, much earlier. "About the beginning of May," he says, "they lay their eggs, as I was once an eye-witness—for a gardener at a house where I was on a visit, happening to be mowing on the sixth of that month by the side of a canal, his scythe struck too deep and laid open to view a curious scene of domestic economy:

> "Ingentem lato dedit ore fenestram;
> Apparet domus intùs; et atria longa palescunt
> Apparent . . . . penetralia."

There were many caverns and winding passages leading to a kind of chamber, neatly smoothed and rounded, and about the size of a moderate snuffbox. Within the secret nursery were deposited nearly a hundred eggs of a dirty yellow colour, and enveloped in a tough skin—but too lately excluded to contain any rudiments of young, being full of a viscous substance. The eggs lay but shallow, and within the influence of the sun, just under a little heap of fresh-moved mould, like that which is raised by ants." He informs us that "in fine weather about the middle of April, and just at the close of day, they begin to solace themselves with a low dull jarring note, continued for a long time without interruption, and not unlike the chattering of the fern-owl or goat-sucker, but more inward." Latreille says the song of the male, which is heard only at evening and during night, is soft and rather agreeable.

Fig. 3465 shows the mole-cricket, with a separate outline of one of its hands; and Fig. 3466, the nest of the same insect, with the eggs.

Among the insects which bury their eggs in the earth by means of an ovipositor, are the Tipulæ, or crane-flies, so abundant in grassy meadows. The ovipositor is simple, bifid at the point, like a pair of pincers, sharp, hard, and horny (see Fig. 3467). The eggs are small and black, and of these each female deposits several hundreds. The position she assumes is very singular. Raising herself perpendicularly on her two hind legs, and resting on the ovipositor, she steadies herself by clinging with the other limbs to the surrounding herbage; she then thrusts the ovipositor in the earth to the first ring of the body, and deposits a single egg; this done, she moves forwards, still maintaining her upright position, and performs the same operation again; and so on till the whole of her eggs are safely lodged in the ground. The maggot, when hatched, attacks the roots of grass and other herbage, and the ravages which myriads of these caterpillars produce is often very serious. They have frequently destroyed entire fields of rising wheat and acres of verdant pasturage.

A minute fly of the same family often proves even more injurious; we allude to the wheat-fly (Cecidomya Tritici), which, by means of a long, slender, tubular and retractile overpositor, deposits its eggs upon the inner chaff, in which the furrowed side of the grain is imbedded, fixing them by a glutinous secretion. They are occasionally placed in the interior parts of the flower and chaff. "A glutinous thread," says Mr. Shireff (Loudon's 'Mag. of Nat. Hist.' Nov. 1829), "frequently connects a cluster of eggs with the style, where the larvæ seem to subsist on the pollen; in one instance fifteen eggs were numbered on such a thread, several of which were suspended on the portion extending between the chaff and the style. The fly seems thus not only to provide a conveyance from the larvæ to the style, but also food for their support. The anthers are prevented from leaving the style, in consequence of being gummed down by the glutinous matter of the fly; the pollen is thereby detained for the use of the larvæ, which would otherwise be in part carried out of the glumes by the expansion of the filaments, known to farmers by the term *bloom*. In the exertion of gumming down the anthers, many of the flies are entangled on the vascules of the corolla, and thus become a sacrifice to their maternal affection.

"The larvæ are produced from the eggs in the course of eight or ten days; they are at first perfectly transparent, and assume a yellow colour a few days afterwards. They travel not from one floret to another, and forty-seven have been numbered on one. Occasionally there are found on the same floret larvæ and a grain, which is generally shrivelled as if deprived of nourishment; and although the pollen may furnish the larvæ with food in the first instance, they soon crowd around the lower part of the germen, and there, in all probability, subsist on the matter destined to form the grain." They appear to pass the winter in the earth in a pupa state, leaving the ears of wheat at the latter part of July. These caterpillars are happily very subject to the attacks of two species of ichneumon-fly, which deposit their eggs in the body of their victim, on which the future larvæ subsist. Were it not for this check to the increase of the wheat-fly, its multiplication would be most alarming.

Fig. 3469 represents the germination of a grain of wheat: *a*, the heart of the grain, the part devoured by the larva; *b*, the bag of the seed; *c*, the root; *d*, vessels to convey nutriment; *e*, *e*, feathers conveying the pollen to fructify the seed.

Fig. 3470 shows the female wheat-fly: *a*, greatly magnified; *b*, larvæ, of the natural size, feeding; *c*, one of the larvæ, magnified.

An allied but rather larger species, the Hessian wheat-fly (Cecidomya destructor), has committed extensive ravages in America. It was first observed in 1776, at Long Island, in the wheat-fields, whence it spread gradually, and in 1788 had extended its range two hundred miles from its original locality. These flies literally appeared in clouds, and such were seen crossing the Delaware, to the consternation of the country. The panic reached England, and the subject engaged the earnest attention of the Privy Council, for great was the probability that the insect might be imported, when the most disastrous consequences were to be anticipated. The female Hessian fly, so called from an erroneous impression that it was conveyed into America among straw by the Hessian troops from Germany, deposits from one to ten or twelve eggs in a single plant of wheat, between the sheath of the inner leaf and the stem nearest the roots; and in this situation the larva, with its head towards the root or first joint, passes the winter, and eating into the stem, causes it to break, and at once destroys all chance of bearing grain. It is easy to conceive the results of the descent of a cloud of these flies over the corn-lands of Kent or Essex. A fly, known in our own country, the Markwick fly (Chlorops pumilionis), the larva of which eats into and destroys the stems of wheat, was erroneously regarded by Mr. Markwick as identical with the terrible Hessian fly, and his published observations respecting it caused no small consternation among the agriculturists. It would appear that it is only the early wheat sown in October that is liable to injury from its visits. At Fig. 3471 both insects are represented: *a*, the Hessian fly (Cecidomya destructor); *b*, the Markwick fly (Chlorops pumilionis) magnified.

All are acquainted with those little white maggots, or larvæ, so common in cheese, and known by the name of hoppers; they are the products of a minute black fly, with whitish wings margined with black, termed the cheese-fly (Piophila casei). This insect, by means of a retractile ovipositor of great length, is capable of penetrating to a considerable depth into the cracks and fissures of the cheese, where it deposits its eggs, between two and three hundred in number. In a few days these are hatched, and commence their depredations. Swammerdam says that the decay of the cheese is really caused by these maggots, for they not only crumble the substance of it into small particles, but moisten it with some sort of liquid, so that the decay rapidly spreads. The cheese-hopper is destitute of limbs, but is provided with two stout horny jaws, which it uses both for digging into the cheese and dragging itself onwards. On being exposed by the breaking up of its retreat, this maggot endeavours to escape by the most astonishing leaps, which, the animal being without feet, are performed in a very singular manner. The larva first raises itself upon its tail, which is furnished with two projections, to enable it to assume and maintain an upright position. It then bends itself, arching its body in the form of a circle, and lays hold of the skin of the tail with its mandibles; it now contracts with all its energy from a circular into an oblong form, and with a sudden jerk assuming a straight line, propels itself to a considerable distance.

The breathing-tubes, or spiracles, of this caterpillar are not placed, as in ordinary cases, along the sides, near the head, and near the tail, a pair being situated at each part; and it is said by Swammer-

dam to have the power of closing the anterior pair by means of a valvular fold of skin, so that when it is in the act of burrowing, all loose particles may be prevented from entering the orifices.

Fig. 3472 represents this maggot and the perfect fly: *a*, the maggot extended; *b*, in an arched position, preparing to spring; *c*, the same, more contracted: *f* and *g*, the fly, of the natural size; *e*, the fly magnified.

There is a group of active predatory insects, termed ichneumon-flies, to which we have already alluded, many of which deposit their eggs in the bodies of various caterpillars, others in the cells of certain bees and wasps. For this purpose the females are furnished with a singular ovipositor, often of considerable length; it consists of a borer, hard and sting-like, between two long blades, which form its sheath. In many cases, perhaps in most, the borer is serrated at the point, which is extremely acute.

Fig. 3473 shows a common species of ichneumon-fly, Pimpla manifestator, and its ovipositor: *a*, the fly; *b*, its ovipositor opened; *c c*, a magnified view of the ovipositor; *d*, the serrated point of the borer.

This insect avails itself of the collection of caterpillars made by the mason-wasp for the support of its own larva, and assaults the cell after it is blocked up with tempered clay, having patiently waited till the whole was completed. By means of her ovipositor she drills through the barricade of clay, and then deeply inserting it, deposits her eggs in the cell by means of the ovipositor, and which not only prepares the way, but also conveys them to their destined situation. Réaumur tells us that, having made an artificial vespiary of sand and mortar upon a wall, he perceived one of these ichneumons at the instant it alighted on the spot under which so many of the little green caterpillars had been stored up by the wasps. Its long tail, or ovipositor, which it carried horizontally, appeared to form but one bristle, though really composed of three, and this it raised, and lowered, and bent in various directions, and soon applied it to the blocked-up entrance of the nest, and worked it in the manner of a bradawl, turning its body from right to left, and the contrary. In this labour it persevered for a quarter of an hour before it succeeded in penetrating to a sufficient depth and reaching the coil of caterpillars, on which its future larvæ were to feed, to the destruction of those of the wasp.

Fig. 3474 shows the ichneumon-fly in the act of depositing its eggs: *a*, an ichneumon-fly at rest; *b b*, its ovipositor; *c*, an ichneumon which has just bored through the clay barricade of a mason-wasp's nest, at *e*, into which her ovipositor, *d*, descends to the roll of caterpillars, *f*, where the egg is laid.

Among the caterpillars which become the victims of ichneumon-flies, that of the common cabbage-butterfly (Pontia Brassicæ) is about the most common. The fly which attacks this, the Microgaster glomeratus, is of small size, black, with yellow legs. Marking its victim, it settles on it, and then deliberately plunges its ovipositor between the rings of the caterpillar's body, and deposits an egg in the wound; this done, it shifts its place, pierces again, and deposits another egg, till twenty or thirty are laid. Though wounded in so many places, the caterpillar seems to feel but little pain, and only gives a slight twitch now and then, as if irritated, nor does the body become swollen. In a little time the eggs hatch; in the meantime the caterpillar eats, grows, and changes its skin as usual; the living parasites within subsist all the while on the living body of the caterpillar, and, strange to say, avoid the vital organs, instinct-guided in their ravages. In due time the caterpillar leaves the plants on which it has fed, and creeps up walls or palings, as if about to undergo its transformation. The parasite larvæ are at this crisis ready to emerge; they eat their way out, change immediately into the pupa state, and envelop themselves in cocoons of bright canary-coloured silk. Clusters of these little yellow pupæ may be seen in autumn on garden walls, and often the withered empty skin of the dead caterpillar in contact with them.

Fig. 3475 represents: *a a*, the caterpillar of the Pontia Brassicæ; *b*, the eggs of the butterfly glued to the leaf; *c*, the Microgaster glomeratus, magnified; *d d d*, the magnified view of a dissected caterpillar, in whose body a number of the larvæ of the ichneumon in question have been hatched; *e*, the silk cocoons spun by these larvæ after their exit; *f*, the larvæ spinning their cocoons; *g*, the larvæ eating their way out of the body of the caterpillar.

But it is not only into caterpillars that ichneumon-flies thus introduce their eggs; there are certain very minute species which absolutely deposit their eggs within the eggs of other insects and spiders, and upon these do the larvæ subsist. Bonnet assures us that he has had ocular demonstration of the fact, and witnessed the evolution not of one, but of a number of these minute parasites from the egg of a butterfly. Others again deposit their eggs in the bodies of perfect insects—the Aphides have an enemy in the Microgaster aphidium. A very rare species, the Evania apendigaster, which has been occasionally found near London, selects that nuisance of our kitchens the cockroach (Blatta) as the living depositary of its eggs (see Fig. 3476, Evania apendigaster, magnified): while a still more rare species, Stylops Melittæ, first discovered by Mr. Kirby, introduces its eggs into the body of the black-bronze bee (Andrena nigroœnea), and perhaps other species. (See Fig. 3477, the Stylops Melittæ, magnified.) The species of an allied genus, Xenos, have been discovered parasitic in wasps, by Professor Peck, in America. Fig. 3478 represents a species of ichneumon, in which the long ovipositor is adapted for probing the nests of other insects.

Let us pass to other insects which bore into the bark or substance on leaves of trees and plants, and there form a nidus for their eggs; instinct-guided in the selection of the vegetable peculiarly suited for the food of the future larvæ: among these are the Cicadæ, or tree-hoppers, the gall-flies (Cynips), and others.

The tuneful Cicadæ (which are not grasshoppers, as the term is often most erroneously translated) are common in the south of Europe, but not in the more northern portions, and but one true Cicada, we believe, is to be found in our island—the Cicada hæmatodes, discovered by Mr. D. Bydder, in the New Forest, Hampshire.

These insects, which Virgil describes as rending the bushes with their song, display the most interesting and curious habits in the mode adopted for securing their eggs. The female, which is mute, is armed with an ovipositor, or, as Réaumur calls it, an auger (tarière), by means of which she is enabled to cut out long cells in the branches selected for the reception of her eggs.

The instrument is of a considerable size, and when not in requisition is lodged in a sheath in a groove of the last abdominal ring, from which it can be protruded at pleasure. When examined with a microscope, it is seen to consist of three portions—a middle horny portion, spear-pointed at the apex, and two horny sheath blades, with nine serrations on each side at the point, acting as a file or saw. The stems of these two files are grooved along their inner side, and each groove is fitted by a ridge of the central borer, so that they both strengthen it, and also slide up and down it, as moved by powerful muscles they rasp or saw the wood. The branch chosen is either dead or very dry, and of such a size that the excavation will extend to the pith, which however is left untouched to form a bed for the eggs. These are very numerous, one female laying from five to seven hundred, and are distributed in many cells: the mouth of each excavation is protected by the little fragments of wood detached during the operation of boring. The larvæ, when hatched, issue forth out of the apertures, seek the ground, and feed on the roots of plants, burrowing through the hard soil. They are transformed not into torpid pupæ, but into active nymphs, remarkable for the strength and size of their fore limbs, which are admirably adapted for digging. Fig. 3479 represents the ovipositor of the tree-hopper, magnified; and Fig. 3480, excavations in a small branch, with the eggs in situ.

The saw-flies (Tenthredo) also deposit their eggs in grooves cut in the stems of twigs or branches, by means of an ovipositor of curious construction. This instrument is retracted within a narrow abdominal slit, and when brought into view and examined by means of a microscope, is found to unite in itself the properties of a rasp and saw. There are two fine and rigid blades, with remarkable serrations, having their backs lodged in a groove formed by two membranous plates, which are thick and stout at the base and narrow at the point; these form a support to the saws, which are worked up and down by the force of muscles acting upon them: besides the saw-edge, these blades have rasping pectinations, or comb-like teeth, on the back of the instrument, which is thus rendered more efficient. Fig. 3481 shows the ovipositor of a Tenthredo protruded from its sheath, magnified. Fig. 3482 shows the ovipositor still more magnified: the comb-like rasps are indicated by the cross-lines. Fig. 3483 shows a portion of the saw, very highly magnified, with the pectinations based upon the transverse lines. When the saw-fly has fixed upon a branch as the recipient of her eggs, she bends her body, protrudes her saw, and works it so as to form a groove in the bark, and in this deposits an egg, gluing it to its place by a sort of frothy secretion; then, moving onwards, she works out another groove, and places in it an egg, as before, and in this way continues till all her eggs, about twenty in number, are deposited. This occupies her more than one day; for Réaumur observed that it took one of these flies ten hours and a half in making six grooves in succession. The grooves appear like small punctures with a lancet, which become wider, with more elevated edges, as the egg increases, till the larva is hatched, and makes its exit. One species of saw-fly, with deep violet wings and a yellow body, and which selects the rose-tree for her eggs, instead of depositing them separately in distinct punctures, forms one long slit, and there deposits them in two parallel rows, each in a little cell-like depression. Fig. 3484 represents the eggs thus arranged.

Of the ravages of the larvæ of the saw-fly on the leaves of the gooseberry and currant trees, especially during certain years, the gardener can unfold a sad account. This insect, the Nematus Ribesii, does not, lie other species, cut a groove in the branch in which to deposit her eggs, but, according to Réaumur—who introduced a pair of these flies under a bell-glass, with a branch of a red-currant bush, in order to watch their operations—the fly passes under the leaf, and there deposits her eggs, six of which were laid and secured to the leaf in the space of a quarter of an hour; but, as he says, without any perceptible groove being cut, notwithstanding the possession of a saw. It is very probable, however, that a minute incision was made, which fitted the egg closely, and applied glue to it, and which might easily be overlooked. In about three weeks the caterpillars are hatched, and feed together in troops, often stripping the trees of every leaf; whole plantations of gooseberry and currant trees are frequently devastated, all hope of fruit being destroyed. The caterpillar is green mixed with yellow, and shagreened with minute, raised, black dots. At its last change of skin these colours disappear, and it becomes smooth, and yellowish white. It has six legs and sixteen pro-legs.

Among our British species of saw-fly there is one, the Nematus Capreæ, the caterpillars of which are exceedingly destructive to various kinds of willow, sallow, and ozier; entirely stripping off the leaves. While feeding they assume singular attitudes and cling by the fore feet. The fly makes its appearance in spring; and the female deposits her eggs in a round patch on the back of the leaf, but not on the nervures, as does the saw-fly of the gooseberry, which it very closely resembles. Another species, of large size, infests the alder (Alnus glutinosa); it is the Selandria Alni of Stephens: the caterpillar is very voracious.

In North America, a species of saw-fly, Tenthredo Cerasi, is most destructive to various fruit-trees—as the cherry, plum, pear, and quince—and has of late years so increased as to produce serious alarm in some districts. The caterpillar is called the slug-worm; and when numbers are collected together, they exhale a most unpleasant odour. The history of this caterpillar, and its devastations, is written by Professor Peck ('Nat. Hist. of Slug-worm,' Boston, 1799).

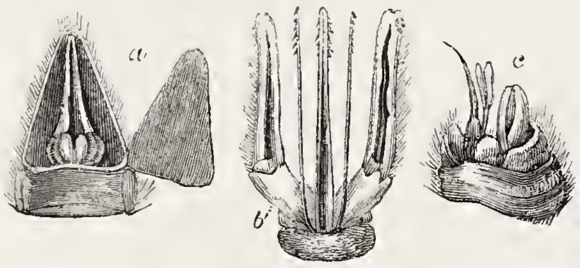
Fig. 3485 represents the saw-fly of the gooseberry—Nematus Ribesii—*a a a*; on the leaf *b* its eggs are shown, adhering to the nervures; *d d*, the caterpillars eating; *c*, one rolled up; *f*, one extended.

Fig. 3486 represents at *a* the caterpillars of Nematus Capreæ, on the ozier; *b*, those of Selandria Alni, on the alder.

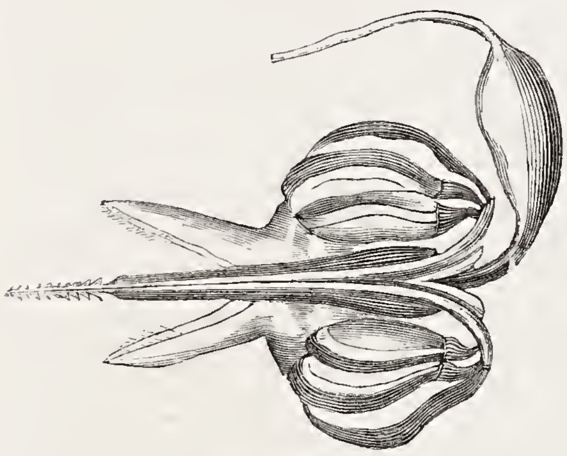
It may have suggested itself to our reader, that excepting as it respects use, there is great affinity between the sting of the bee or wasp and these keen ovipositors, which we have noticed in the ichneumons and saw-flies; and such is really the case, and as its details will be perhaps better understood by being compared with the ovipositors mentioned, we may here say a few words respecting it.

The sting of the bee is really a formidable instrument, and so extremely acute, that a good glass will not render the extreme point visible, as it will that of a needle. It consists of an extensile sheath, enclosing two needle-shaped darts much finer than a human hair, and scarcely to be distinguished by the naked eye; these with the sheath together form the sting, and the whole of the parts are numerously barbed at the point; hence when plunged into the skin, the bees can seldom withdraw them, and they are consequently wrenched out of the insect's body, most probably to its speedy destruction: the sting is moved by powerful muscles, eight in number, according to Swammerdam, which by their action protrude from its recess and urge into the skin; it appears that each part of the sting is capable of separate movement. On more than one occasion, when the sting of a wasp, the point of which has been just forced into the skin, has with the whole apparatus been torn from the insect's body, have we seen the muscles continue their movements, and that for a considerable time. Was the sting of a wasp or bee a simple sharp weapon, it would give not so much pain as the puncture of a needle, but, as we well know, it produces very great pain and inflammation; this pain is owing to a poison which the sting distils into the wound, and which is secreted in a large sac attached to the base of the weapon, and communicating with it by means of a fine tube, through which the poison flows. The sac

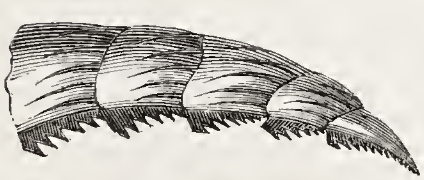
3486.– Caterpillars on the Ozier and Alder.



3487.– Sting of Bee.



3488.—Poison-Bag of Bee.



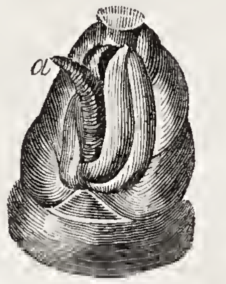
3483.—Part of Saw-Fly's Rasp.

3485.—Saw-Fly of the Gooseberry.

3475.—Ichneumons and Caterpillars.

3476.—Evania apendigaster.

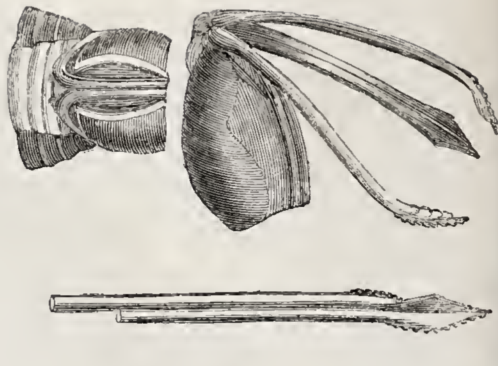
3480.—Excavations for Eggs of Tree-hoppers.



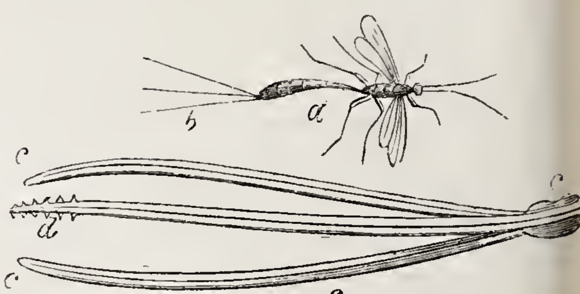
3481.—Ovipositor of Saw-Fly.

3477.—Stylops Melittæ.

3482.—Ovipositor of Saw-Fly.

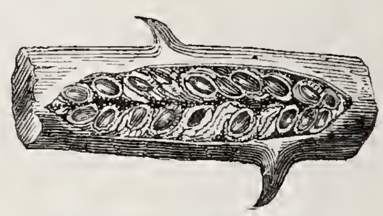


3479.—Ovipositor of Tree-hopper.

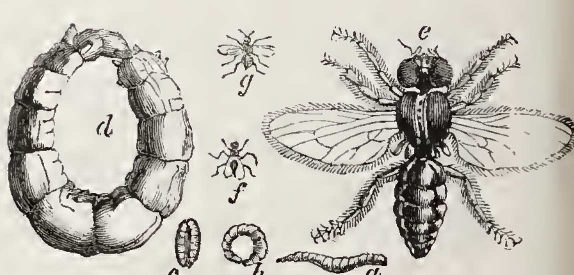


3473.—Ichneumon-Fly and Ovipositor

3478.—Ichneumon-Fly.



3484.—Eggs of Saw-Fly in Rose tree.



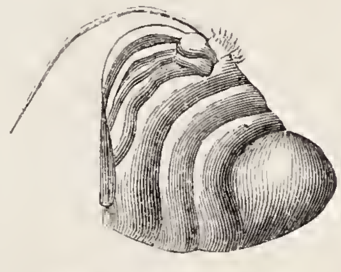
3472.—Cheese-hoppers and Fly.

3474.—Ichneumon-Flies ovipositing.

3494.—Artichoke-galls of Oak.

3498.—Oak-apple Galls.

3489.—Galls on Oak-leaf.



3490.—Ovipositor of Gall-Fly.

3499.—Root-gall of Oak.

3495.—Galls of Dyer's-Broom Insect.

3497.—Semi-gall on Hawthorn.

3500.—Woody Gall of Willow.

3496.—Galls of Oak.

3492.—Bristle of Bedeguar of Rose.

3501.—Currant-galls on Oak.

3502.—Gall of Hawthorn-Weevils.

3491.—Gall-Fly.

3493.—Bedeguar-gall of wild Rose.

is acted upon by a strong muscle with which it is surrounded, and which by its contraction forces the fluid through the tube.

As in the case of snakes, the poison of the bee and wasp appears to have acid properties, and will change vegetable blues to red.

Instances are on record in which persons have lost their lives from the attack of a horde of bees; and serious results from their stings are by no means of uncommon occurrence. To small animals it is fatal; and Fontana considers a single grain sufficient to destroy a pigeon.

Fig. 3487 exhibits the structure of the sting of the common bee: *a*, the terminal ring of the abdomen, cut open so as to expose the recess in which the sting and its appendages are seen; *b*, the sting and its appendages removed from the abdomen; *c*, a profile of the sting and appendages: all are greatly magnified, but in different degrees. Fig. 3488 shows the poison-bag of the bee attached to the base of the sting, highly magnified.

From this digression respecting the sting of the bee, we pass to other groups of ovipositing insects; and the gall-flies (Cynips), of which the species are very numerous, will engage notice.

Whoever looks at a willow tree will see on its leaves, often very abundantly, oval reddish or brown tubercles or elevations; on opening these each will be found to contain a minute larva: oak-apples, as they are popularly called, are familiar to every one; these again are tenanted within by larvæ: in both these instances the larva is that of a species of the Cynips family.

Similar excrescences, in the form of little round berries, may be seen on the leaves of the oak, produced by the Cynips Quercus-folii. (Fig. 3489.)

The Cynips lays her eggs by means of a long ovipositor, which in some species is conspicuous at all times, but in most is coiled up spirally within the abdomen, and invisible until protruded, when it appears like a very slender curved needle, longer than the body of the insect itself. The mechanism by which it is darted out is analogous to that connected with the tongue of the woodpecker, and it is completely under the control of the insect. Fig. 3490 represents the ovipositor of a species of Cynips greatly magnified. Fig. 3491 shows the mode in which it is coiled up in the abdomen, and the fly itself highly magnified. By means of this instrument the Cynips pierces the outer skin or cuticle of the leaf, or twig, and introduces her egg, accompanied, probably, by some secretion capable of deranging the organic actions of the circulatory and secretory vessels, for in a short time the egg becomes surrounded by a thickened layer, which gradually increases, assuming different forms according to the species of Cynips, and of the tree it has selected. The gall tubercle may be then considered as the result of diseased action on the part where the puncture has been made; but what it positively is that produces that diseased action, and how it is that the same kind of gall should invariably be produced by the same insect, are points respecting which we are in the dark. Besides, in many instances it is not a mere nut or apple that is produced, but a truly morbid excrescence, with unnatural filaments like moss growing over it. Look at the Bedeguar-gall of the dog-rose, produced by the Cynips Rosæ. This is so common that it must be familiar to all; it is a sort of ball or apple, covered with red mossy filaments, on the stems of wild dog-roses. This singular excrescence results from several punctures, and the deposition of as many eggs, and is often of considerable size. In this the larvæ live, each lodged in its own cell, and as they there pass the winter, the thick mossy covering preserves them from the intense severity of the cold, and is the more necessary, as the hedges are bare of leaves, and afford but little shelter, besides which the excrescence is often seated high, and exposed to the wind. Early in the spring the larvæ undergo their change into the pupa state, previously to which they work their way out of the dried and indurated gall-nut by means of their sharp mandibles, and in summer undergo their final change into the winged state, to decorate in their turn the rose-trees with other mossy balls.

The filaments which compose the mossy covering in question are individually slender and branched, as seen at Fig. 3492. Fig. 3493 represents the bedeguar-gall of the wild rose, much less than the ordinary size.

Another species, the Cynips Quercus-gemmæ, produces very singular galls, termed from their scaled appearance artichoke-galls. They are placed on the twigs, and might be mistaken for buds; in size they exceed a filbert, and are composed externally of concentric leaves, overlapping each other like pointed scales, and are evidently intended as a means of protecting the larvæ within from the cold of winter. To theorize on the mode in which these leaflets are produced is useless; however, it may be they are rapidly formed, as indeed are all other galls, and soon acquire their full growth. Fig. 3494 exhibits these artichoke-galls of the oak, with the Cynips that makes them, of the natural size; *a*, the ovipositor, magnified.

A structure in some respects similar is produced on the stalk of the Dyer's Broom, by the Cynips Genistæ. These galls, which vary in size from that of a filbert to a walnut, are generally of a globular shape, the stem passing through the centre; externally it is composed of a multitude of leaflets, each rolled up, the point ending in a bristle. Internally its substance is fleshy, and on it feed multitudes of larvæ so minute as to be discerned with difficulty. It would seem that the buds of the branch bearing this gall never push out into shoots, but only develope leaves, which are all rolled up and turned round the stem, indicative of a general morbid action.

Fig. 3495 represents the leafy galls of the Dyer's Broom: A, one of the galls; B, a leaflet from it, magnified.

A very remarkable gall, but by no means common, is produced on the oak by a species of Cynips. It appears in the form of a woolly or cottony substance around the twig at the origin of the leaves, and might be mistaken for a cluster of the Aphis lanata, covered with their white down. Internally the gall resembles in substance the bedeguar of the rose, but the cells in which the larvæ are lodged are not so irregularly scattered, but arranged at the offgoings of the leaf-stalks; there are also small isolated groups of cells. The woolly covering is analogous to the moss which invests the bedeguar of the rose, and is probably intended also as a protection against cold. Fig. 3496 represents the woolly gall of the oak, less than the natural size.

The young shoots of the hawthorn are subject to the attacks of a fly, not a Cynips, but probably a Cecidomya, which produces a semigall, formed by a crowded bunch of leaves, which appear curled and half withered, and, as it were, crumpled up together; the twig which they terminate is stunted, and the intertwined leaves, moreover, are covered with minute spines; among these leaves numerous minute white larvæ work their way, keeping, however, in the centre of the foliage which encloses them. This kind of semi-gall is represented at Fig. 3497.

Those galls of the oak called oak-apples, so often seen on the slender twigs, are formed by a species of Cynips (Cynips Quercûs), and often attain to a large size. They are more or less rounded like a small apple, but less regular and with indentations on the surface; the skin, however, is smooth and of a greenish yellow, more or less tinged with a ruddy hue. At the time of their first formation they have a few leaflets at the base, but these soon fall off. Their substance is fleshy. If one of these oak-apples be split vertically, a number of granules will be seen, in each of which is a minute larva; and running to these granules from the stem are an equal number of fine fibres, of which the granules are the termination. It is probable that these fibres are the nervures of what would have been leaves, and Réaumur thinks that they do carry sap to nourish the morbid excrescence, or gall-nut. The perfect insect makes its appearance in June or the beginning of July. Fig. 3498 shows two oak-apples on the twig of an oak, and one cut open vertically, displaying the granules and their vessels.

Galls are often to be found on the bark of the oak at the line of junction between the root and stem. They are similar in structure to the oak-apple, and are probably produced by the same or a closely allied species, and at a season of the year in which the buds or young twigs are unfit for the reception of eggs. These kinds of galls are shown at Fig. 3499.

Clusters of very curious galls are often found on the oak, which in size and appearance a good deal resemble the oak-apple, but which are really very different. Each of these galls contains but a single larva; the outer surface is hard, woody, and yellowish: beneath this the structure is fleshy and spongy, and in the centre of the fleshy inside is a small hard case, or inner gall, in which the larva will be found to reside; numbers of these galls, from two to seven or eight, each distinctly separated from its neighbour, are frequent on the extremity of the branches.

The willow often exhibits galls of a very similar structure, with this difference, that, instead of one cell only, there are several, irregularly distributed through the inner fleshy substance. These galls are seated either on the body of a branch or at its extremity; they are covered with a smoother bark than that of the branch upon which they grow. Fig. 3500 represents the Woody gall on a willow-branch.

The name of Currant galls has been given to several kinds, but particularly to those which grow on the catkins of the oak; they adhere to the catkins, which hang more or less thickly loaded with them, bearing no little degree of resemblance to straggling bunches of currants or bird-cherries. They appear to be produced by a species of Cynips closely allied to that which causes the small round galls on the leaf of the oak. Fig. 3501 represents these pendent currant galls.

We may here notice the galls of commerce, so valuable as one of the ingredients used for dyeing, and so remarkable for their astringent quality and bitterness. These are the production of a species of Cynips, and occur chiefly on the quercus infectoria: they vary in size and quality, the largest equalling a nutmeg in magnitude, while others are not much larger than a pea, and no doubt they are produced by a distinct species of fly. The surface is generally covered with irregular lines and little ridges, and their external crust is hard and woody. One variety is white or yellow, another dusky olive green, grey, or nearly black. The white variety is the largest, but the least esteemed, and is often pierced with a small aperture, through which the insect had made its exit. These are obtained in Syria and Cyprus. The best or dark galls are imported from Aleppo and Smyrna.

Galls enter into the list of articles of the Materia Medica, but their employment is very limited. They are used in making ink.

Galls are not exclusively the production of the Cynips family of insects. It appears that certain species of beetles, called Weevils (Curculio), have the power of introducing their eggs into the substance of leaves, or beneath the cuticle of bark. Kirby and Spence have ascertained that tubercles found on the roots charlock (Sinapis arvensis) are due to the operation of a species of weevil (Curculio contractus.) The roots of the hollyhock (Alsea rosea) are often much injured, and all covered with rough excrescences, which contain the larvæ of other species; and those on the roots of cabbage-plants are tenanted by larvæ also; others dwell in woody galls on the leaves of the Guelder rose, the lime, and beech. The hawthorn also is subject to galls produced by weevil. One of these is described by Mr. Rennie as placed at the extremity of a branch, and enfolded by a bundle of leaves, which on being opened displayed a brownish rounded woody substance, resembling the galls of some of the Cynips tribe. On being opened a small yellowish grub appeared coiled up, and feeding on the exuding juices of the tree; it was placed in a pasteboard box with a fresh shoot of hawthorn, but it made no attempts to construct a cell, or attack the fresh shoot—a proof that the egg was originally introduced by the puncture of the parent. Yet though thus exposed to the air, and deprived of a great portion of its nutriment by the loss of a portion of its cell and the drying of the rest, it went through its changes, and at last appeared in the form of a small greyish brown beetle of the Weevil family. Mr. Rennie adds that in 1830 these galls were very abundant during the summer. Fig. 3502 represents the gall of this species of weevil on the hawthorn: *a*, the gall opened to show the grub.

Besides Weevils, there are certain two-winged flies, as the thistle-fly (Tephritis Cardui), which produce woody galls, on the thistle; or, as another species does, on the common white briony (Brionia dioica). In the latter, the fly lays its eggs near a joint of the stem; the grubs live upon its substance, and the joint swells into an oval excrescence furrowed in several places. We have already alluded to the semigalls or partial galls of the gall-gnats (Cecidomyæ).

Many species of Aphis produce partial galls, or cells, on the leaves of trees and plants, which serve as 'procreant cradles.' In some cases these cells are complete without any aperture, in others they are in the form of inflated vesicles with a narrow opening on the under side of the leaf, the convex surface of the vault rising on the upper side. We often see this distortion of the leaf in the mountain ash (Pyrus aucuparia). Often indeed the cells are very large, and, though open underneath at first, the orifice becomes ultimately closed, in consequence of the repeated punctures made by the insect round its edge, from which the sap is exuded, and which are followed by a diseased action which soon ends in the closure of the aperture. If the cell be examined in its early stage, it will be found to contain a single pregnant female; but if when closed up, a numerous brood will meet the eye, and these, by the punctures they make in order to obtain nutriment, extend the influence of the deranged action of the leaf, and enlarge the walls of their domicile. The species in question is the Aphis sorbi; Fig. 3503, magnified.

Let us at once, however, prevent any misconstruction respecting the cells or excrescences produced by the aphides; these insects do not puncture the cuticle of the leaf with an ovipositor, and deposit an egg in the orifice made; on the contrary, it is with the beak that they puncture plants, and that for the sake of food, though, as often happens,

a double end is answered: thus the punctures made for the primary object, viz. food, subserve a second, and induce changes in the structure of the leaf connected with the preservation of the young; we say the young rather than eggs, because the aphides appear to be viviparous, and when what are termed eggs are deposited, they are really young aphides enclosed in a sort of cocoon, and which pass the winter in a torpid state. Such at least is ordinarily the case, and what is more remarkable is this, that the aphides which make their appearance in full activity are females exclusively, and prolific, being endowed with almost incredible fecundity; but no males are found till the autumn. It is not in fact necessary for the young female aphides produced during summer to pair with a male, which indeed would be impossible, as there are no males to be found, yet these females go on producing their young daily, these young themselves still fertile; and from a series of experiments suggested by Réaumur, and conducted by some of the French academicians, it was made manifest that nine generations came successively into being, without pairing, in the course of three months. Réaumur calculated that one aphis may be the progenitor during its life of 5,904,900,000 descendants.

To return to the cells or galls made by these insects: among the more remarkable are those produced, on the leaves of the black poplar, by a species termed Eriosoma populi, which in June or July may be seen carried about as it were by the wind, and appearing like a little tuft of snow-white down. Its body is in fact covered by long downy filaments, which rather impede the use of its wings, though they may contribute to its buoyancy, as it floats in the air; as among other aphides some are winged, others not, nor are all covered with this white down, which is perhaps peculiar only to the females, and during a certain portion of the summer. How this may be is not well ascertained. This species punctures the leaves and leaf-stems of the poplar, feeding on the exuded juice; and each female, having fixed upon a convenient spot, there remains stationary, repeating her punctures, till by degrees a thick fleshy wall begins to rise around her on the injured leaf, and at last encloses her in a cell, a small opening remaining in some part. Here she brings forth a numerous brood, and these in turn enlarge the cell, and feed on the flowing sap, till, having attained the winged state, they make their exit, spread abroad, and found new colonies.

Fig. 3504 shows the galls produced on the black poplar by the Eriosoma populi, and the various forms of the insects, winged, wingless, and covered with down, both of the natural size and magnified.

It is extremely common to see the leaves of various plants and trees curled up and distorted, with a host of aphides embowered within the chamber thus formed; the leaves of the raspberry bush are very frequently thus affected, and become the nests of these insects, into which, however, the lady-bird (Coccinella) finds her way, and thins the living multitude. It is also very common to see on the leaves of the currant tree, numerous red bulgings irregularly clustered together, which when examined will be found to be concave underneath, and filled with aphides (aphis ribis), feeding on the juices of the leaf, which becomes thus diseased and deformed by their punctures. See Fig. 3505, a leaf of the currant bush, distorted by these insects.

In like manner the succulent twigs and tender shoots of plants become warped and unnaturally twisted, and even spirally contorted, by the operations of these insects, as seen at Fig. 3506.

A pretty pseudo-gall is produced on the Scotch fir (Pinus sylvestris) by one of the largest of our aphides, the Aphis pini; it is a scaled excrescence, not unlike the fruit of the tree in miniature, and of a reddish colour. It generally appears on the terminal shoots, and may be found during the summer months. (Fig. 3507.)

While speaking of galls and other unnatural appearances resulting from insects, we may observe, that singular excrescences are often to be observed on shrubs and trees, in which no larvæ can be discovered. These morbid tumours may have arisen from disease originating in the branch itself, or produced by some external injury, sometimes, perhaps, by the attacks of insects. Fig. 3508 shows a branch of the bramble thus diseased; and Figs. 3509 and 3510, two twigs of the hawthorn in a similar condition.

From the morbid tumours, called galls, on the trees, resulting from a wound followed by the introduction of an egg, we may turn to consider somewhat analogous tumours produced in the skin of living animals. All have heard of the Breeze-fly or Gad-fly of the ox (Œstrus bovis, Clark; Hypoderma bovis, Latr.)—a dipterous fly—termed, as Virgil says, Asilus by the Romans, and Œstrus by the Greeks; and from his day to the present, notorious as the terror of the herd.

The gadfly of the ox has the chest of a dark brown colour, with a yellow patch on the back, and the abdomen has alternate rings of black and yellow. The appearance of this fly drives the cattle mad with terror; they utter loud bellowings, gallop over the fields,

> "and scour the plain
> In all the bright severity of noon:"

exhausting themselves with efforts to escape.

The female of this insect is generally believed to deposit her eggs in the fatty and cellular part of the skin of cattle, by means of a singular ovipositor, consisting of a horny tube shutting up in four pieces sliding within each other like a telescope; the terminal portion ends in five points, which together constitute a borer. Of the five points, three appear to be curved, the other two are straight and shorter. By some the puncture with this instrument is said to cause temporary but intense pain, an acrid secretion being, it is supposed, instilled into the wound; and it is from an instinctive dread of the suffering it produces, as they insist, that the herd are scattered by the fly when it makes its appearance. The Œstrus tarandi, however, is an equal terror to the Reindeer, and according to Linnæus this fly lays its eggs merely on, not in, the skin of that animal, the grub afterwards burrowing its way and causing large tumours.

Some naturalists consider that the puncture of this fly does not occasion any pain, and that numbers of eggs are deposited in places on the hide, from which the ox could have lashed off the insect with its tail, and Réaumur says that he has seen an ox flap away the ordinary flies collected upon a part full of these tumours.

On the contrary, Mr. Bracy Clark contends that the gadfly does not pierce the skin with its ovipositor at all, but merely glues it to the hairs, and that afterwards the grub eats its way under the skin, causing swelling and suppuration. It is indeed difficult to decide between such conflicting opinions, for it is almost impossible to bring the matter to the test of personal observation. Réaumur, who supposes a puncture, though without pain, to be made, says, "Whenever I have succeeded in seeing these insects at work, they have usually shown that they proceeded quite differently from what I had imagined, but unfortunately I have never been able to see one of them pierce the hide of a cow under my eyes." If then the gadfly does not pierce the skin, or pierces it without giving pain, to what are we to attribute the terror of the herd? The same query equally applies to the terror displayed by the reindeer, of which Linnæus says, that "though amongst a herd of five hundred there were not above ten of these flies, every one of the herd trembled and kept pushing its neighbour about," and that "when the fly touched any part of their bodies, they instantly made efforts to shake it off." It has been suggested that the buzzing noise of the gadfly strikes the cattle with instinctive terror, as the whirring noise made by the rattlesnake does those animals liable to the reptile's attack.

Again, we are assured that the gadfly of the horse (Œstrus equi) is beheld with every sign of agitation by the latter, and assuredly that species deposits its eggs on the hairs.

Leaving then the question open as to whether the gadfly of the ox makes a puncture or not, certain it is that at a very early period the grubs are found beneath the skin of the beast; where they lie, tumours, called warbles, form, and suppuration takes place in the cellular tissue; it is on the purulent matter that the grubs feed, and as they grow, the tumours become more extensive. Each grub is thus as it were a tenant of a cell at once protecting it and supplying it with nutriment. These tumours have each an external orifice, and this is necessary for the due respiration of the grub; its spiracles are placed at the hinder part of the body, and the position the grub occupies brings the tail to the orifice, through which it emerges, rising to a level with the external surface; another object besides the freedom of respiration is answered by this orifice remaining open—it gives to the purulent matter a free exit, and prevents the suppuration from extending to a dangerous degree. In due time the grub has attained its full growth and is ready to assume the pupa state; it now pushes its way through the orifice, and falling to the ground, burrows in the earth, passes through a brief season of torpor, and appears in August a winged gadfly, to continue its progeny. Many of the grubs, however, perish; various birds watch their egress from the tumours, and seize them as they are endeavouring to escape. The jackdaw and magpie are expert at this service to cattle; and the Pique Bœuf of Africa (see vol. i. p. 342) is of the same benefit to the large antelopes, &c.

Referring to our pictorial examples, Fig. 3511 represents the ovipositor of the breezefly or gadfly greatly magnified, with a hooked claw and part of the tube still more enlarged.

Fig. 3512 represents *a* the under surface of the grub of the Œstrus bovis; *b*, the upper surface; *c*, the caudal extremity greatly magnified; *d*, the tumour or warble, with the tail of the grub appearing at its external aperture.

Fig. 3513 represents the fly, the pupa and grub of the Œstrus bovis, with a magnified view of the pupa.

Fig. 3514 represents the tumours or warbles produced on the hide of cattle by the Œstrus bovis. To these tumours the farmer pays too little attention; the grubs are easily removed by pressure, and it is certainly better to relieve a beast from their annoyance than to suffer them to remain.

The terrible zimb mentioned by Bruce in his travels, which lives during the grub state in the hide of the elephant and rhinoceros, the ox and the camel, appears to be related to the present species, but, if Bruce is to be trusted, the zimb produces far more formidable effects.

MM. Humboldt and Bonpland discovered a species in America, probably closely related to the Œstrus bovis, which attacks man himself. The perfect insect is about as large as a housefly, and the tumour formed by the grub is generally in some part of the abdominal region; the grub requires six months to come to maturity, and if irritated is apt to work its way deeper into the flesh, and thus sometimes occasions fatal inflammation.

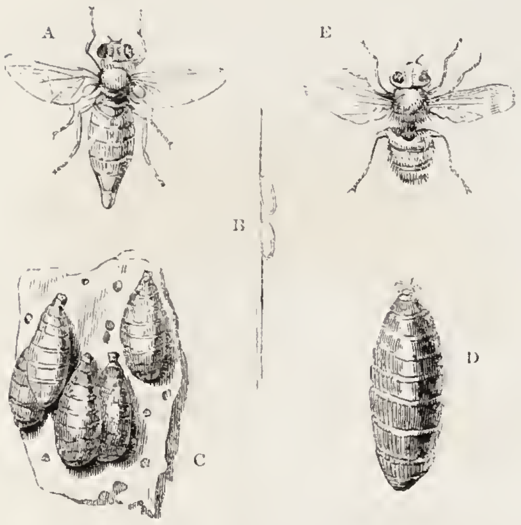
With respect to the Œstrus equi, or horse gadfly, it glues by means of its ovipositor its eggs on the hair of the horse, instinctively selecting some part which it can reach to lick with its tongue; and, after depositing her store to the number of fifty or a hundred, soon perishes. These eggs may be seen about the shoulders and legs of horses turned out to grass in August. Two or three days after being deposited they are ready to be hatched. Possibly the horse feels a little inconvenience from all this glutinous matter sticking about and stiffening the hair, and he licks the part, and by the pressure of the tongue, and the mingled influence of the warmth and moisture of it, the ova are burst, and a small worm escapes from each. It clings to the tongue, and is thus conveyed into the mouth; thence it is either carried with the food into the stomach, or, impelled by instinct, it travels down the gullet, being of too tiny size to inconvenience or annoy the horse. Thus it reaches the stomach, and, by means of a hook on each side of its mouth, affixes itself to the cuticular or insensible coat of that viscus, into which its muzzle is plunged; there it remains until the early part of the summer of the following year, feeding on the mucous or other matter which the coats of the stomach afford. It has now become an inch in length and of corresponding bulk, and ready to undergo its change of form. It detaches itself from the cuticular coat to which it had adhered, and plunges into the food which the other and digestive portion of the stomach contains; it passes with the food through the whole length of the intestines, and is discharged with the dung. It then hastens to burrow into the earth, and, if it has escaped the birds that are eagerly watching for it, it has no sooner hollowed for itself a convenient habitation than a shelly covering is formed around it, and it appears in the state of a pupa or chrysalis.

It here lies torpid for a few weeks, preparing to undergo its last change. It assumes the form of a perfect fly; it then bursts from its prison, rises in the air, and seeks its mate. The work of fecundation being accomplished, the male immediately dies: the female lingers a day or two in order to find the proper deposit for her eggs, and her short life also terminates.

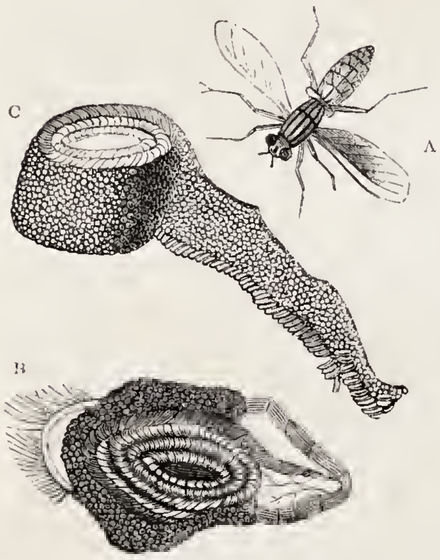
The numbers of these larvæ or bots with which the stomach of the horse is sometimes crowded are almost incredible; we have seen large patches of them in close array; they occupy the cardiac portion, and are said, formidable as they seem, to produce no mischief; at least such instances are rare and accidental, other causes combining with their presence. Occasionally they have fastened about the larynx, and produced a distressing cough, which no medicine could alleviate, and which became more and more aggravated as the larvæ increased, till the sufferer sank under the exhaustion produced by incessant irritation.

Fig. 3515 represents—A, the female of the Œstrus equi, nearly twice the natural size; B, two eggs, magnified, deposited on a hair; C, bots, one half their natural size, adhering by their tentacular mouths to the cuticular portion of the stomach. Excavations are seen in the cuticular coat, showing where others had been recently fixed; D, the full-grown bot detached; E, the Gadfly of the sheep (Œstrus ovis). The latter fly lays her eggs on the inner margin of the nostril of the sheep, and the larvæ creep up the nostril, threading the sinuosities of the way, and causing the most dreadful irritation, which almost maddens the poor animal; ultimately they reach the frontal sinuses, and fasten themselves on the living membrane, from which when fully grown they detach themselves and creep down again, and

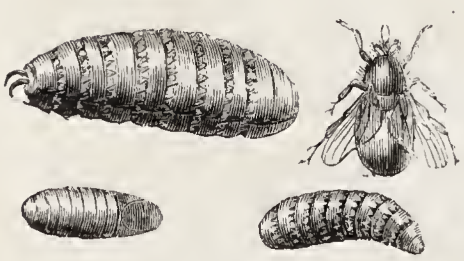
3514.—Tumours on Cattle, produced by Gadfly.



3515.—Gadflies and Bots.

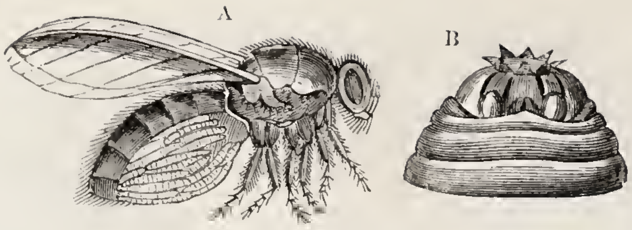


3517.—Chequered Blow-Fly and Larvæ.



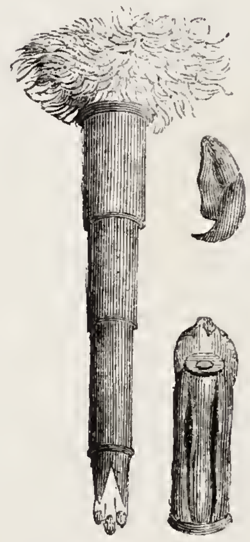
3513.—Gadfly and Grubs.

3508.—Pseudo-gall on Bramble.



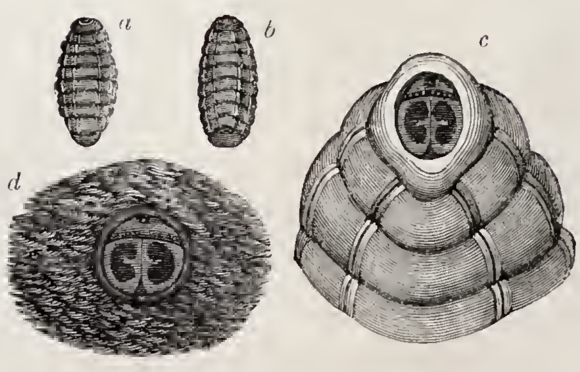
3518.—Large Grey Blow-Fly.

3509.—Pseudo-gall on Hawthorn.



3511.—Ovipositor of Gadfly.

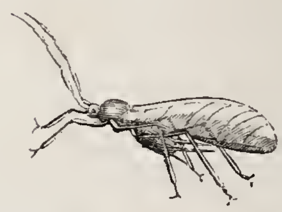
3506.—Lime-twig contorted by Aphides.



3512.—Details of Gadfly.

3504.—Eriosoma and Galls on Poplar.

3510.—Pseudo-gall on Hawthorn.



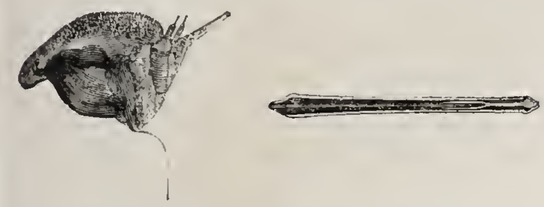
3503.—Aphis sorbi.

3516.—Ovipositors of Insects.

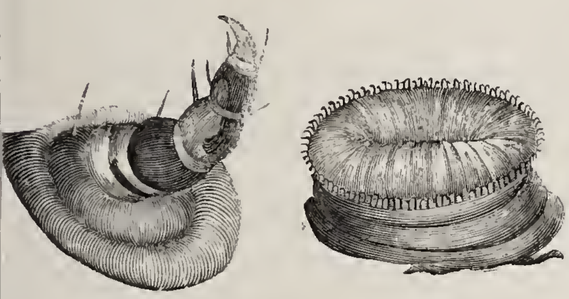
3507.—Pseudo-gall of Aphis pini.

3505.—Galls of Aphis ribis on Currant-leaf.

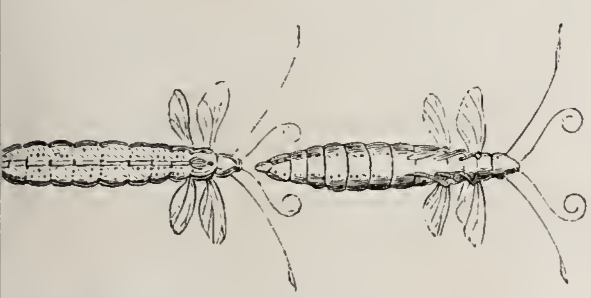
3523.—Caterpillars of Swallow-tail Moth.



3528.—Silk-tube of Caterpillar of Goat-Moth.

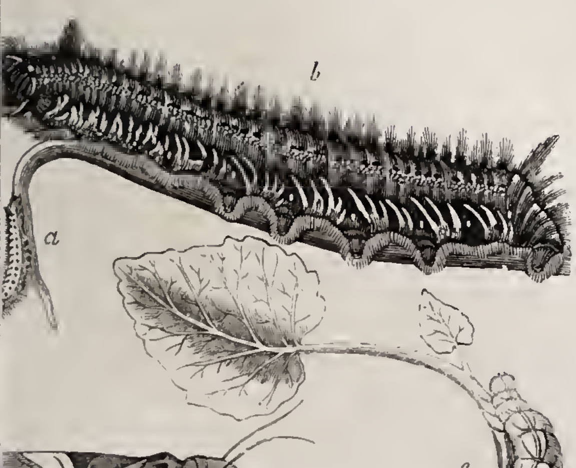


3524.—Leg and Pro-Leg of Caterpillar.

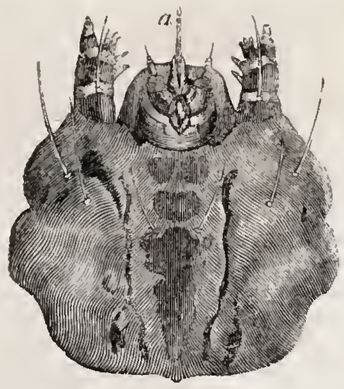


3531.—Embryo Cabbage-Butterfly.

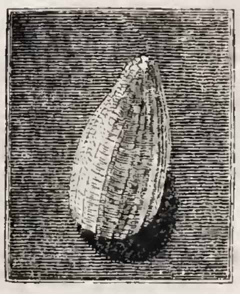
3525.—Caterpillar of Goat-Moth.



3522.—Caterpillars of Drinker and Angle-shades Moths.

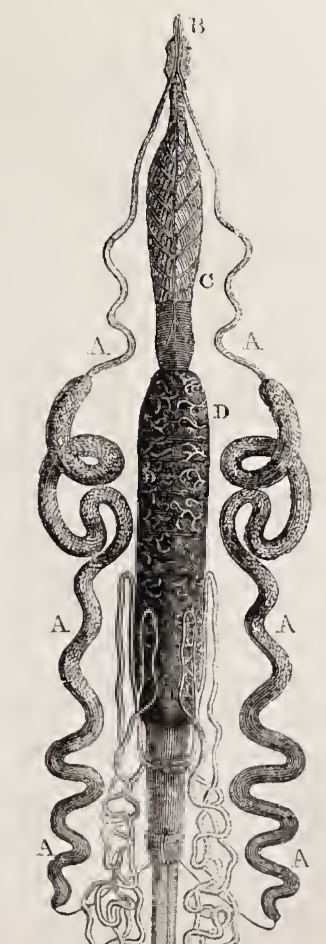


3527.—Labium of Caterpillar of Goat-Moth.

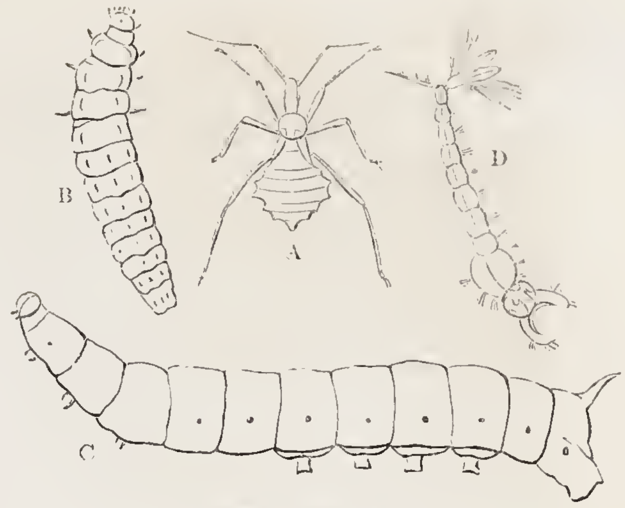


3529.—Egg of Cabbage-Butterfly.

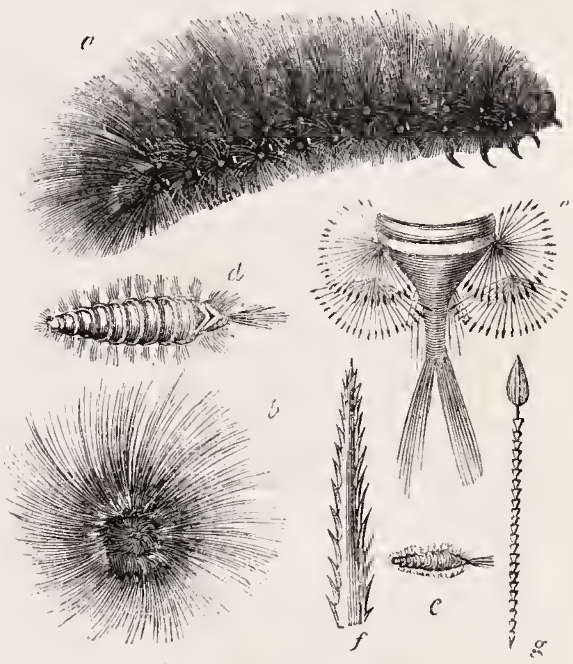
3530.—Cabbage-Butterfly.



3526.—Organization of Caterpillar of Goat-Moth.

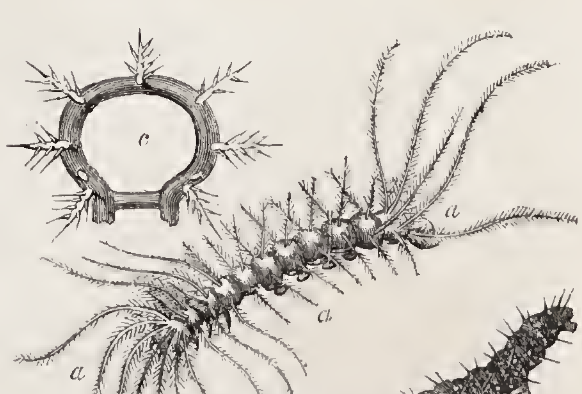


3519.—Larvæ of Insects.



3520.—Caterpillar of Tiger-Moth.

3532.—Caterpillars of Admirable Butterfly.



3521.—Spiny Caterpillars.

till fairly got rid of annoy the animal exceedingly: having attained the earth, they bury themselves, assume the pupa condition, and in two months reappear as perfect insects.

Fig. 3516 shows at one view by way of comparison the ovipositors of several insects already described.

We have said that some insects are ovoviviparous, that is, they produce not eggs, but living young. There is reason to believe this to be the case with most of the aphides, and it is so with certain dipterous flies, as the chequered Blow-fly (Sarcophaga carnaria), and others. It would appear that in these flies there is a large abdominal pouch into which the eggs are transmitted, and where, fostered by the warmth of the sun, the larvæ become disclosed, and ready to be deposited upon putrescent animal matters. The eggs indeed of the blow-flies which are oviparous, as the shining green blow-fly (Musca Cæsar, Linn.), and the common bluebottle (Musca vomitoria, Linn.), very soon, during the sultry weather of August, become grubs or as they are often termed maggots; but in the case of the chequered blow-fly, even this rapid change is anticipated.

This latter species is of a more slender figure than the common bluebottle, and of a dark colour with light stripes on the thorax. The female measures about one third of an inch in length, and is provided with an abdominal sac for the reception of the eggs, which are arranged in the form of a roll of riband, and before exclusion assume the larva state. Réaumur took the trouble to uncoil this roll of compacted flies in embryo, and found it to measure about two inches and a half in length, and to contain about twenty thousand individuals. After this statement we shall cease to wonder at the suddenness with which large masses of decomposing animal matter become as it were instinct with life, heaving and moving with crawling myriads, appointed to act as the scavengers of nature.

Fig. 3517 represents – A, the chequered blow-fly; B, the abdomen opened and magnified, showing the coil of young larvæ; C, the coil of larvæ partially unwound.

Another large grey blow-fly with red eyes, the species not ascertained, was also found by Réaumur to be ovoviviparous, but in this the larvæ were less numerous, and instead of being disposed so as to form a spiral coil in the abdominal pouch, were arranged longitudinally. Fig. 3518 represents this fly at A, with the abdomen opened, showing the young maggots; and B, a peculiar respiratory apparatus, something like a coronet, observed at the caudal extremity of the maggots, and capable of being shut down or raised at pleasure.

We may now proceed from the eggs of insects to consider more definitely the caterpillars or larvæ of insects, the changes they undergo, their modes of life, their means of protection, and their general habits and manners—subjects all of the highest interest.

We may premise by observing that the larvæ of insects form two great divisions considered as to the degree of their perfection, and indeed Burmeister bases his system of entomology on this point, making two primary groups, which he calls Ametabola, and Metabola. Without laying any stress on Burmeister's system or urging any objections against it, we may observe that the first division consists of two orders of insects, namely the Hemiptera, and Orthoptera, including in the latter his Dictyoptera, viz. cockroaches; and in these, the larva resembles the perfect insect, but is destitute of wings; and the pupa, instead of being motionless and torpid, runs about and eats, and exhibits rudiments of wings: such pupæ are called nymphs, the former term being applied to such as are torpid and limbless (the terms chrysalis, from golden markings, and aurelia, rather apply to the pupæ of butterflies). Of the ametabolous division the water boatman (Notonecta) one of the Hemiptera, the cricket, locust, grasshopper, &c., are examples. The second division Metabola includes all the other orders. In these the larva does not resemble the perfect insect, and is a grub or maggot without legs, or a caterpillar with legs. The pupa, chrysalis, or aurelia is mostly limbless externally, though the limbs may be often seen beneath the case, and generally it is quiescent, for though it can stir when irritated, it neither moves about nor eats.

At Fig. 3519 are represented in outline, four larvæ illustrative of our observations. A, an ametabolous larva, or nymph of an Hemipterous insect (Zelus); the others are metabolous; B, the larva of a beetle or coleopterous insect (Telephorus); C, the caterpillar of a lepidopterous insect (Sphinx); D, the larva of a dipterous insect, a gnat (Culex), and of aquatic habits.

Now as respects the non-locomotive powers, and abstinence from food of metabolous pupæ, there are many exceptions; for example, the aquatic larva of the dragon fly (Neuroptera) becomes a pupa with limbs, which moves about and eats; the same remark applies to the ephemeræ and gnats, as far at least as regards their locomotive powers. The fact is, that so diversified are the forms and characters of larvæ, and so various are the circumstances connected with their metamorphosis, and so diversified is their condition in the pupa state, from the cricket, cockroach, or earwig, in which the pupa closely resembles the perfect insect or imago, and enjoys active existence, to the pupa of the silk-worm shrouded in its cocoon, that it is difficult to lay down definitions to which all will conform.

The structure and varieties however of larvæ, their peculiar changes, and the condition of the pupæ, will be best understood from the pictorial specimens upon which we shall comment.

All caterpillars, grubs, or larvæ, on exclusion from the egg are small; they increase rapidly in size, and are voracious; some carnivorous, others herbivorous. Those of many coleoptera or beetles, and of Diptera or two-winged flies, are destitute of eyes; and in others these organs are largely developed. Many have large and powerful jaws, as those of butterflies and moths, though in the perfect insect the mouth is haustellate. Some larvæ are quite naked, others are covered with hairs, and others again furnished with spines. These appear to be intended to be a protection against natural enemies, and indeed, if Madame Merian be correct, those of the caterpillar of Urania Leilus are as hard as wire. According to Abbot, many caterpillars in America sting like a nettle, and blister the hand when touched; and indeed the caterpillar of the gypsey moth of our own country (Hypogymna dispar), is covered with slender hairs that produce considerable irritation of the skin. In many instances the long closely-set hairs of caterpillars enable them to fall from considerable elevations without injury; like the hedgehog they roll themselves up and drop down, the elasticity of their hairs preventing the concussion of the body; like that quadruped, also, when alarmed or in danger, they roll themselves up, and present a chevaux-de-frise of slender bristles. This is exemplified in the caterpillar of the tiger moth (Arctia Caja). Referring to Fig. 3520—*a* represents the hairy caterpillar of the tiger moth; *b*, the same rolled up for defence; *c*, the hair-tufted grub of the museum beetle (anthrenus musæorum); *d*, the same magnified; *f* and *g*, its hairs magnified; *e*, the tail of the same magnified. This larva, the pest of cabinets, being covered with tufts of diverging hair, is very difficult to lay hold of, for such is their smoothness and elasticity that it slips between the fingers almost like quicksilver.

In certain butterflies (Vanessæ) the caterpillars are defended by hard sharp bristles or thorns, as those of the "peacock's eye," which are of a dark colour freckled with white, and feed in groups.

Fig. 3521 represents three spiny caterpillars—*a a*, a caterpillar figured by Madame Merian; *b b*, the caterpillar of the peacock's eye (Vanessa Io); *c*, a supposed section with the spines magnified.

Fig. 3522 represents the tufted caterpillar of the drinker-moth (Odonistis potatoria), at *a*, in its early stage; at *b*, full grown; *c*, the smooth caterpillar of the angle-shades moth (Pholgophora meticulosa); *d*, the moth of the same. Naked as this caterpillar is, it exists during the winter, in the heart of savoy cabbages and other esculents of the garden, feeding in open weather. In its last moult it changes from a clear green to a yellowish brown.

The larvæ of many insects, as of the bees and wasps (Hymenoptera), and of flies (Diptera), have no limbs, but crawl by means of a vermiform action of the body, or are passive. The larvæ of a few beetles, as of some of the weevil tribe (Rhycoptera), are in the same condition. In larvæ of the Lepidoptera, as butterflies and moths, there are two kinds of legs: viz. true or persistent, and pro-legs or temporary legs. With respect to the first, they consist of three pairs attached respectively to the three first segments of the body, the future thorax, and are the rudiments of the legs of the perfect insect; they are horny and pointed. The pro-legs are soft, short, and conical; they vary in number in different species. The caterpillar of the common cabbage butterfly has five pairs; these feet are furnished with a set of minute slender horny hooks round a disc-like sole or sucker, by means of which the animal is enabled to lay a very firm hold on the leaves of plants or other objects, and also to move along with tolerable dispatch. It is to be observed that when five pairs of these limbs are present, none are found on the fourth, fifth, tenth, or eleventh segments, but a pair respectively on the sixth, seventh, eighth, ninth, and twelfth segments, the twelfth segment being the last. In some caterpillars there are only two pairs of these limbs, one pair on the last segment, one on the ninth; such are the geometrical larvæ, so called from their measuring their progress in a very singular manner, namely by assuming the form of a pair of callipers or rather of the Greek Ω (omega). At the commencement of their movements they form an arch, bringing the anterior and posterior segments of the body, on which are seated the true limbs, and the pro-legs, closely together. To take the first step they stretch out the head to the full extent of the body, secure themselves firmly, and then bring up the rear, assuming the Ω form again. Among the more popular names for these caterpillars of a tribe of moths, are loopers and surveyors. When at rest they clasp with their pro-legs the twig on which they are placed, and without using the true limbs assume various attitudes at an angle with the twig, of which many seem to be an offset or fork. They feed in the night, and are ready when disturbed to drop down by means of a thread of silk from their spinneret. Fig. 3523 shows the geometric caterpillars of the swallow-tail moth (Ourapteryx sambucaria), in different attitudes on a twig of which they seem portions.

There are other variations in the number of the pro-legs of caterpillars, but in none are the segments mentioned as destitute ever furnished.

Fig. 3524 represents the leg and pro-leg of a caterpillar magnified; the pro-leg terminates in a hooked acute claw; the sucking disc of the pro-leg is seen surrounded by the circle of little hooks.

Many caterpillars, as is well known, spin silk: some for cocoons for themselves in which to undergo their last change, as the silkworm; many weave tents for themselves in which they dwell; others nests and cells; and others form threads by which to suspend or secure themselves.

The spinneret of the caterpillar differs in many points from that of the spider.

The spinneret of the caterpillar is between the labium and two first limbs; it appears in the form of a protuberance or little tube, with a single orifice for the fluid silk, conveyed there by two fine ducts which unite into one before their termination; the tube is said by Lyonnet to be composed of alternate portions of horny and membranous substance, and is cut at the end something like a writing pen. The ducts are the continuations of two long slender and tortuous sacculi, running internally down each side, in which the silk is secreted in the form of a gummy fluid. The capacity and length of these sacculi vary in proportion to the quantity of silk required, and in the silk-worm these reservoirs are very extensive, far more so than in the much larger caterpillar of the Cossus ligniperda, or goat-moth. Fig. 3525 represents the larva of the goat-moth, in which we may observe "en passant" that the respiratory orifices or stigmata along the side are very perceptible. Fig. 3526 represents the internal organization of the same caterpillar—A A, the sacculi in which the gummy fluid, constituting the silk when drawn forth and hardened, is secreted; B, the silk tube, through which the silk-gum is forced by a peristaltic muscular action; C and D, the digestive apparatus. Fig. 3527 represents the labium of the caterpillar of the Cossus—*a*, the silk tube or spinneret. Fig. 3528 exhibits a side view of the silk tube, and a section of the silk tube magnified twenty-two thousand times.

Having noticed the silk apparatus with which so many of the caterpillars of the Lepidoptera are furnished, let us follow one of these creatures from the egg, Fig. 3529, to the perfect insect, Fig. 3530 (Pontia Brassicæ).

On its exclusion from the egg, we repeat, the caterpillar is of very small size; its growth, however, is as rapid as its appetite is voracious. Its increase, however, is accompanied by successive moults of skin, for its cuticle is not extensible, at least beyond a certain point, if at all, and therefore, like the armour of the lobster, must be repeatedly changed. The change is thus effected: beneath the original cuticle, or epidermis, which in due time begins to be loosened, a new one is formed; a rent takes place, from the swelling out of the animal, down the back of the old skin, and this rent gradually increases till the caterpillar, with a brighter epidermis, frees itself from its discarded weeds, and appears of larger dimensions. During this process, which is often repeated, the caterpillar is sluggish and inactive, and refuses food; but when the process is over it recovers its former voracity. During all this time the caterpillar is laying up an accumulation of fat to serve the wants of the system during the time of its torpid pupa state, which it is now preparing for. Beneath the last cuticle assumed, the vital energies of the system have developed wings, antennæ, a slender proboscis, and all the parts of a perfect butterfly or moth that is to be. This last cuticle, or epidermis, is, however, yet to be cast off, and another is formed to clothe the pupa, or chrysalis, which in its turn is to be broken open for the exit of the perfect insect. Previously, however, to the pupa state being assumed, it secures itself by means of its silk in a position varying according to the species. Suppose it merely suspends itself by the tail; in this case the first care of the caterpillar is to cover the spot to which it is about to suspend itself with successive layers of

silken threads which readily adhere, till at last a little silken eone is produced, into which the caterpillar pushes its hinder pair of pro-legs (those on the last segment), which become entangled and so fixed amidst the threads; it then permits itself to hang down with the head lowermost. In a short time it begins to bend its back, bringing the head near the attached pro-legs, and after continuing for some time in this attitude it straightens itself and repeats the same action. In about twenty-four hours the outer skin begins to split down the back, and the fissure is enlarged by the swelling and pressure of the chrysalis, till at length the head and adjoining portion of the suspended chrysalis beeome disengaged, the skin shrivelling up into a bundle surrounding the tail. This, however, has to be thrown off, and at the same time the chrysalis has to avoid disengaging itself from its mooring of silken threads from which it hangs; for, be it remembered, it was by its hind legs that it attached itself. To effect this operation, one of no little nicety, it seizes on a portion of this shrivelled skin between two segments of its body, holding it as with a pair of pineers, and thus destitute of limbs supports itself till it withdraws the tail from the old useless skin which sheathed it; it then, still clinging, elongates the rings of its tail as much as possible, and seizes a higher portion of the skin, and in this manner, elimbing backwards as it were upon its exuviæ, it repeats the manœuvre till the extremity of the tail presses the silk, to which it immediately adheres by means of a number of hooks provided for the purpose. Still these exuviæ encumber it, and hang in contact with it; curving its tail in such a manner as partly to embrace the shrivelled skin, it whirls rapidly round, jerking violently, and at length succeeds in disengaging the slough from its fastenings and throwing it to the ground. In a short time the chrysalis hardens (for at first it is very soft) and shows through the outer case the wings, antennæ, eyes, and legs of the perfect insect. It now passes into a sort of torpid state till the time arrives for the exit of the perfect butterfly from its case.

That the organization of the perfect butterfly or moth was developed under the external aspect of the caterpillar, though the different parts were then in embryo, was known to Swammerdam, and also to Malpighi and Réaumur, and has been demonstrated by dissections, which, on account of the delicate nature and softness of every portion of the internal structure, are not easily accomplished. Swammerdam hardened the caterpillars by immersion for some hours in spirits of wine and vinegar mixed together. Fig. 3531 represents the upper and under surface of the butterfly in embryo, within the mask of the caterpillar. The wings, antennæ, and trunks are spread out to show them.

The duration of the pupa or chrysalis state of existence varies in different species, and even in the same, the escape of the perfect insect being retarded by eold, and aeeelerated by warmth—a wise provision as it respects the safety of the matured insect. When ready for exclusion the butterfly bursts the skin of the chrysalis now to be thrown off which eovers the thorax, and emerges feeble and languid, with wings crumpled up into small bundles. Soon, however, the body acquires strength, the fluids circulate, air is driven through the nervures of the wings, these gradually unfold, and the creature quivers then as it feels its growing powers. At length, in the perfection of strength and beauty, it leaves its sordid mummy-case behind, soars aloft, and seeking the flowers of fields and gardens commences a new existenee.

Such is the progress of the butterfly from the egg to its perfect condition; from—

"The worm,—a thing that crept
On the bare earth, then wrought a tomb and slept"

to the hovering "Psyche."

Fig. 3532 represents the caterpillars of the Admirable Butterfly (Vanessa antiopa): *a*, one of them weaving its button of silk; *b*, one suspended by its hinder pro-legs from the silk button; *c*, one bending itself in order to split the old skin.

Fig. 3533 shows at *a* the suspended caterpillar of Vanessa antiopa splitting its skin for the evolution of the chrysalis; at *b* the head of the chrysalis emerging, and at *c* the same proeess farther advanced; *d*, the perfect pupa.

Fig. 3534 represents the pupæ of the small Tortoiseshell Butterfly (Vanessa urticæ), suspended to the silk by their terminal hooks: *a*, a front view; *b*, a lateral view; *c*, a magnified view of the terminal hooks; *d*, the old skin shrivelled up and rejected.

Some caterpillars secure themselves still more ingeniously, and frequently in a horizontal position, by binding themselves to their support by a belt of silken threads round the body. Such is the case with those of the hair-streak butterflies (Theclæ). The caterpillar, having first secured itself at the tail, draws back its head, and pushing out its spinneret makes a sort of loop, or girth, of silk, fastened at each end; when this is sufficiently strong it insinuates itself under it, and the cincture embracing the middle of the body binds it seeurely. In this position it awaits the ensuing change. The caterpillar of the black-veined white butterfly constructs a similar cincture, but in a manner somewhat different, being of an elongated form and very flexible; it bends its head back, and by throwing threads across its body, each duly fixed to the branch (the under side of which it occupies), it binds itself secure. Fig. 3535 shows *a*, the caterpillar of the black-veined white butterfly spinning its suspensory band; *b*, the chrysalis horizontally bound to a branch; *c*, the butterfly (Pieris Crategi) smaller than in nature.

The caterpillar of the splendid swallow-tailed butterfly (Papilio Machaon) constructs a loop also for its suspension; having secured its caudal extremity, it forms a suspensory girdle, using its hooked limbs in keeping the threads on the stretch till fifty or sixty are fastened; the loop thus formed is about twice the diameter of the body, and this it slips over its head to wait, suspended, its approaching metamorphosis. This caterpillar has two retractile horns on its head, the use of which is not very clear. Fig. 3536 shows *a*, the caterpillar of the swallow-tailed butterfly weaving its suspensory cincture; *b*, the caterpillar suspended waiting its change; *c*, the chrysalis suspended in a similar manner.

By means of their silken threads many eaterpillars, like the spider, can lower themselves at pleasure to the ground, and remount their slender cordage. Their method, however, differs from that of the spider, the spinnerets of which are at its hinder extremity; the spider drops with the head downwards and turns round to remount, which it does by means of its triple-clawed limbs, coiling up the line as it proceeds; the caterpillar, on the contrary, drops with the caudal extremity downwards; the spinneret being near its mouth, and having short limbs, the anterior ones being smooth and horny, it eannot ascend with great dispatch: its plan of operation is to grasp the line with its posterior prolegs, and at the same time raise its head; then using the other pro-legs it ascends step by step.

Fig. 3537 shows two caterpillars of the Emperor moth (Saturnia Pavonia), one descending, the other ascending its silken thread—in comparison with the garden-spider (Epeira diadema) ascending.

The geometrical caterpillars, when at rest, have always a thread secured, by which to drop when alarmed. Fig. 3538 shows the caterpillar of the Brimstone moth thus prepared: *a*, the caterpillar in its resting position, with the thread fastened; *b*, the moth (Humia cratægata); *c*, the eggs; *d*, a young caterpillar.

In some instanees, caterpillars have been observed to use their silk-apparatus with great address under peculiar circumstances. Rösel saw the caterpillar of the goat-moth, when confined in a drinking-glass, contrive to escape with what we may term great ingenuity; it applied the adhesive silk-gluten to the glass, and so spun a succession of ladder-steps from the bottom of the glass to the top, ascending them as it continued its labour. Fig. 3539 shows the caterpillar of the goat-moth thus making its escape.

But the silk of caterpillars serves for other and more important purposes; for, as we have said, some shroud themselves in a cocoon, and thus enveloped undergo their last change; while others weave tents and habitations, in which to dwell. Among the former we may instance the silk-worm or caterpillar of the Bombyx mori: see Fig. 3540—*a* and *b*, the male and female moth; *c*, the eggs; *d*, the pupa removed from the cocoon; *e*, the caterpillar; and Fig. 3541, the caterpillar.

In this species the caterpillar is about eight weeks in arriving at maturity, during which period it changes its skin four or five times, and ultimately prepares for assuming the pupa state. It now prepares a nest of silk, or cocoon, the whole of which is composed of a single thread, arranged in two modes. To form the exterior envelope, the caterpillar, having fixed upon a spaee between two leaves or two stems, or other convenient site, draws a thread from its spinneret and fixes it to an adjoining surface; it then conducts the thread to another point and there secures it, and this it continues, drawing the threads from point to point, in various directions, until it has surrounded itself with a loosely spun maze, the scaffolding for the support of the interior cocoon. Fixing itself by its pro-legs to some of the surrounding threads, it bends its head from side to side, and spins a layer of silk-threads, to which it incessantly adds until it is sufficiently deep; it then shifts its position, and repeats the operation in another plaee, and so on, repeating its labours till the cavity is reduced to the proper size. Hence, therefore, the cocoon is not formed of a thread wound round and round the caterpillar, but backwards and forwards, in a series of zigzags, so as to form a number of separate pads or cushions. The length of the thread composing the inner or true cocoon, without including the exterior case, is not less than 900 or 1000 feet; but so great is its tenuity that the threads of five or six cocoons require to be put together to form one of sufficient thickness for the working of the manufacturer. The thread of the inner cocoon alone is valuable; the outer tissue is too much interwoven to be wound off. We must add, that the chamber of the true cocoon, in which the pupa is housed, is lined with a tapestry of silken threads gummed to each other, so as to form a uniform surfaee; this appears to be effected by drawing from the spinneret a more delicate silk, and then uniting the fine threads with gum or fluid silk, given out in sufficient quantity to bind them all together.

Here, then, in a shroud of pale yellow glossy silk, the caterpillar beeomes a pupa; and here, if permitted, the pupa throws off her last investment, and emerges a perfect moth. But the question now is, how is the moth to get out of the silken tenement in which while a caterpillar she had locked up herself, leaving no aperture? The moth makes her way out by destroying the continuity of the silken threads at one end of the cocoon by means of a liquid solvent discharged from its mouth; it then presses forward, and the cocoon opens. The latter, however, is now utterly spoiled for all useful purposes, and hence the breeders kill the pupa by exposing the eoeoon to a certain degree of heat.*

In like manner the puss-moth (Cerura vinula) opens its cocoon, composed of particles of wood and sand, cemented together by a sort of gum or fluid silk, which hardens into a mass. Fig. 3542 represents the cocoon of the puss-moth; the interior of which is occupied, in this specimen, by several cocoons of a parasitic ichneumon (Ophion vinulæ), the caterpillars of which had preyed upon the pupa of the moth, and then woven in her tenement their own cocoons.

In Bengal, the caterpillar of a moth, the Phalæna paphia, which feeds on the jujube-tree leaves, produces a coarse silk, known as Tusseh silk, from which a dark coarse cloth is manufactured of a very durable quality.

The Arrindy silk-worm, or caterpillar of the Phalæna Cynthia, produces threads of so soft a texture that it cannot be unwound, but is spun into thread like cotton. From this is manufactured a cloth of loose texture, but of great durability. Neither of these moths has received any attention from European silk-growers.

A very curious cocoon is spun by the eaterpillar of the Emperor Moth (Saturnia Pavonia), a large and splendid species; the caterpillars are represented at Fig. 3543. They spin a cocoon of a pyriform shape, of strong silk, so thickly interwoven, that the tissue has the appearanee of damask or leather; the apex of this cocoon is open, a narrow circular aperture being left, round which converge stiff threads of silk, gummed together, needle-shaped, and almost as elastic as whalebone. This arrangement prevents the intrusion of depredators. But, as if to make the cocoon doubly secure, within the aperture the eaterpillar construets a sort of dome, which acts as a barrier, should the entrance be forced. The eocoons of the caterpillar of the Emperor Moth are represented at Fig. 3543, cut open to show their structure.

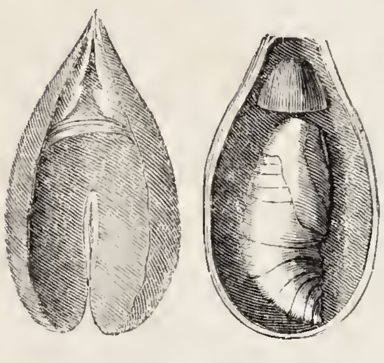
A very different structure of eocoon is prepared by the caterpillar of the beautiful Cream-spot Tiger-moth (Arctia villica), which lies in the pupa or chrysalis state only about three weeks, and therefore does not require a strong and substantial eovering. It consists of a maze of threads, loosely surrounding the pupa, which may be discovered through the loose and light envelope. The cocoon of Arctia villica is shown at Fig. 3544. That of another species still lighter and more elegant is seen at Fig. 3545. In this the threads form a fine network, like delicate gauze, investing the pupa within.

Of the caterpillars which weave tents in which multitudes cluster together, all assisting in the strueture of their common dwelling, we may notice the small Ermine Moth (Yponomeuta evonymella), which sometimes abounds in myriads, stripping the hedgerows of foliage; these caterpillars are gregarious, and weave filmy webs, with which we have sometimes seen the naked hawthorns festooned. Having consumed all the provisions in the neighbourhood of their encampment, and the leaves enclosed within their tent, they all change their quarters, and construct another encampment. The Lackey Moth (Clisiocampa Neustria) is also gregarious, and spins tents in which extensive colonies reside, often to the injury of the fruit-trees which they infest.

Some caterpillars, as those of the Browntail Moth

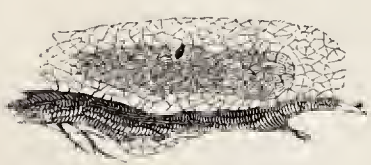
* Réaumur was of opinion that the moth rasped her way out by using her eyes as a file, and thus opened a passage through the cocoon. Mr. Swayne denies that the threads are broken at all, either by a solvent or by filing; and affirms that he has succeeded in unwinding a whole cocoon from which the moth had escaped.

3540.—Silk-worms, Moths, &c.

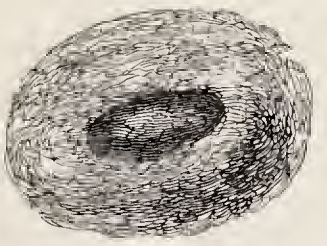


3543.—Cocoons of Emperor-Moth.

3541.—Caterpillar of Silk-worm.



3545.—Network Cocoon.

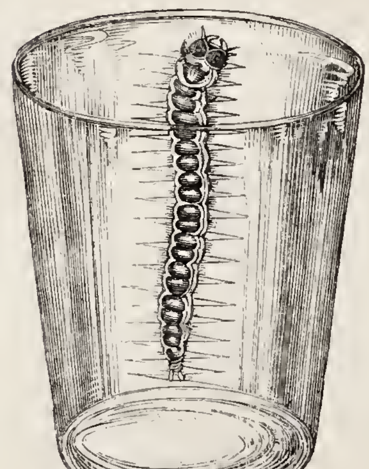


3544.—Cocoon of Cream-spot Tiger-Moth.

3537.—Spider, and Caterpillars of Emperor-Moth.

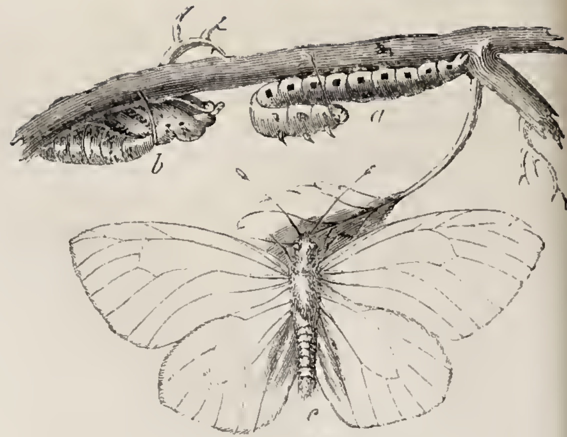
3538.—Brimstone-Moth.

3546.—Nest of Caterpillars of Brown-tail Moth.



3539.—Caterpillar of Goat-Moth.

3547.—Nest of Caterpillars of Golden-tail Moth.



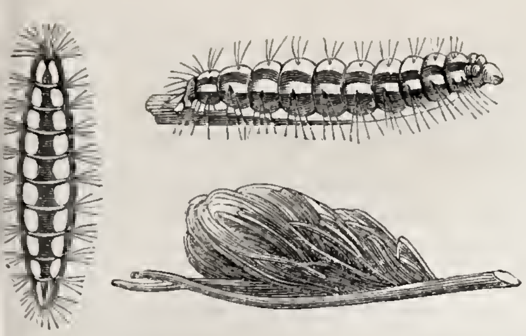
3535.—Black-veined White Butterfly.

3533.—Suspended Caterpillars and Chrysalis.

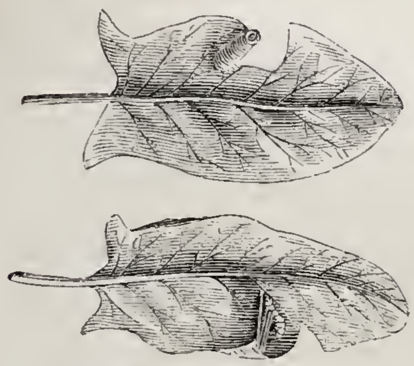
3542.—Nest of Puss-Moth.

3536.—Caterpillar of Swallow-tailed Butterfly.

3534.—Chrysalis of Tortoiseshell Butterfly.



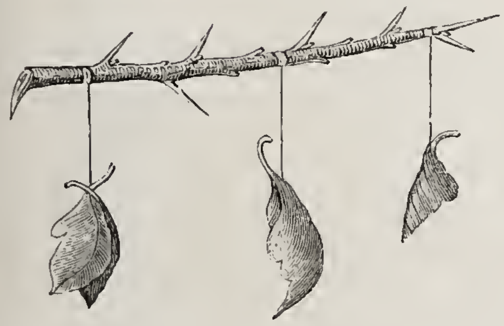
3560.—Cypress-spurge Caterpillar and Nest.



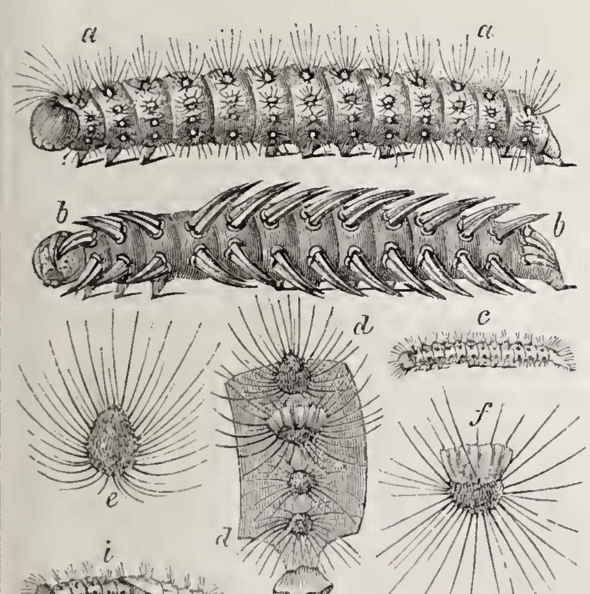
3556.—Leaf-rolling Caterpillars of Sorrel.

3550.—Lilac-tree Moth.

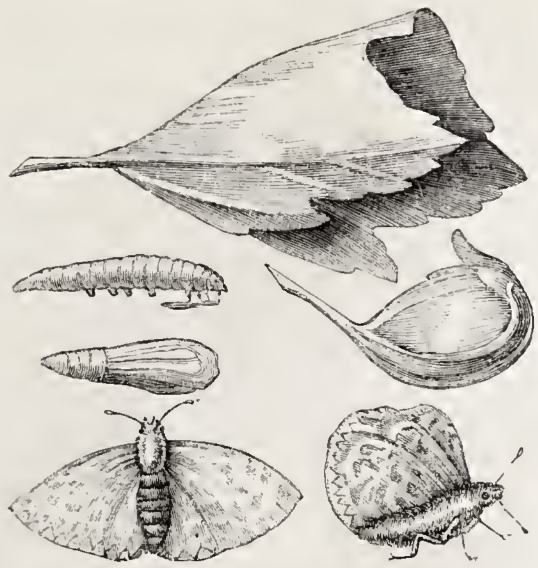
3553.—Green Oak-moth.



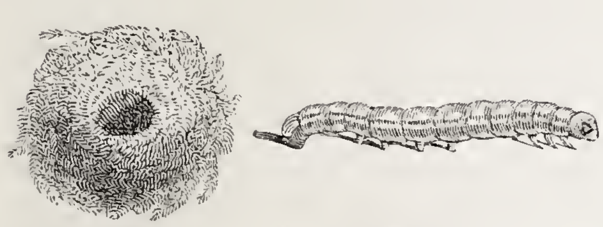
3549.—Pendulous Leaf-Nests.



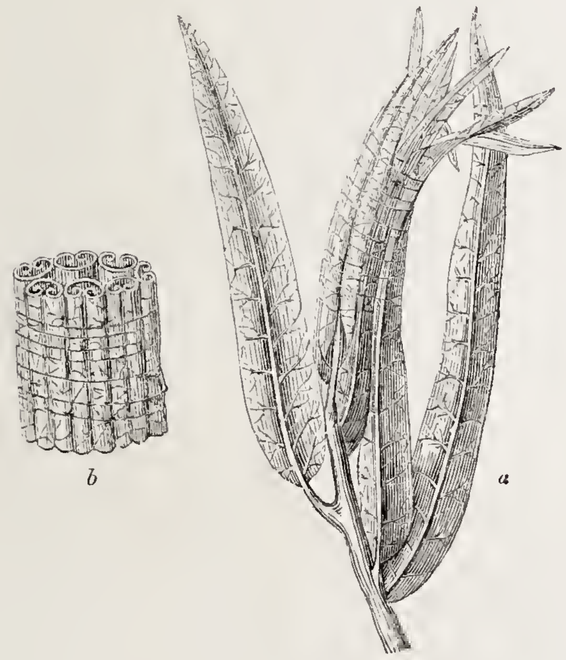
3562.—Moulting of Caterpillars.



3557.—Nest and Stages of Hesperia malvæ.



3561.—Caterpillar and Moss Cell of Bryophila perla.



3558.—Nest of Tortrix chlorana.

3559.—Zigzag and Nest of Osier-leaves.

3548.—Processionary Caterpillars of Oak.

3552.—Nest of Lilac-leaf-Roller.

3551.—Nest of Lilac-leaf-Roller.

3555.—Nest of Nettle-leaf-rolling Caterpillar.

3554.—Caterpillars and Nest of Green Oak-moth.

(Porthesia auriflua), which are gregarious in their habits, spin close and warm nests on the twigs of various trees, in which they pass the winter. These nests are composed of grey silk, with which sometimes leaves are intermingled—not, however, as a necessary part of their structure, but accidentally. They vary in shape, and are sometimes suspended to one twig only, sometimes they are attached to several. Internally this nest is divided into cells or chambers, in each of which one, two, or three caterpillars lodge. Previously to the cold weather the partitions between these chambers are very slight, but as the season advances their thickness is increased, and before the frost sets in the whole is made substantial and comfortable. Fig. 3546 shows the nest of the social caterpillars of the Brown-tail Moth.

The caterpillars of an allied species, the Golden-tail Moth (Porthesia chrysorrhæa), construct similar nests for winter, and are lodged in numerous compartments within. Fig. 3547 shows the winter nest of this species, with one cut open to show the compartments and the caterpillars inhabiting them.

It must here be observed that in the nests of these social caterpillars, which are subdivided into compartments within, apertures are left for the exit and entrance of the caterpillars, which often march out in bodies, emerging from various openings, and ramble to a great distance in quest of food, returning on the approach of a shower of rain, or when the evening draws to a close: they follow each other, not perhaps quite regularly, but still in some degree of processional array, the track of one being always pursued by others. On looking closely at their track, we find it marked by a pathway of silk, which each emits from its spinneret as it travels, however great the distance may be; the line of a leader, who leaves the first deposit as he proceeds, is consequently the most convenient for others in succession to take, every one in turn contributing to pave the road. One great purpose to be answered by this plan is the security afforded to the travellers over twigs and leaves, and along the branches; for the deposit of gummy silk adhering to the bark gives a firm grasp to their pro-legs. Another purpose served is that it is a clue by which to return. They follow the road they themselves have made, and it leads back to their starting-point—the snug nest which they had left in the morning.

In the South of Europe there are certain caterpillars of a moth (Cnethocampa processionea) termed by Réaumur 'Processionaries,' from the remarkable habits they display of moving in a long file, headed by a leader. They feed upon the oak, and when newly hatched the multitudinous brood divides into parties of several hundreds. These unite their exertions together, and weave a large nest often nearly two feet long, and five or six inches in diameter. It is not divided into chambers within, but constitutes a large hall, or room of assembly, with only one door for exit and entrance. Hence it happens that there is only one leader, or pioneer, for in the track of the first that sets out paving the way with silk, the rest instinctively follow:—at first in single file, then in two or three deep, and at length in five or six. The appearance of hundreds of caterpillars thus moving along in military array, the long line winding its tortuous way, is very singular.

There is another species of caterpillar found in the pine-woods of Savoy and Languedoc, which, according to Réaumur, displays the same processionary habits. The nests, he states, are smaller than those of the last species, and have several chambers with a main entrance, with others besides. They are composed of silk of excellent quality and great strength, which Réaumur thought might be turned to a commercial advantage. From the main entrance issues the leader, and the rest follow in order due; thus they conduct their foraging expeditions, and return by the same route to their nests.

Fig. 3548 exhibits the nest and order of march of the Processionary caterpillars of the oak (Cnethocampa processionea, Stephens).

There are still other ways in which the caterpillars of the Lepidoptera avail themselves of their silk; many, for example, bind leaves together, or roll them up and secure them with silken threads, lining the chamber within with a soft tissue.

Bonnet describes a very beautiful pendulous nest consisting of one or two leaves neatly folded and held together with silk, and suspended by a thread of silk from the branches of fruit-trees; in these nests live several caterpillars in harmony together. Fig. 3549 represents these pendulous leaf-nests, from Bonnet.

The process of rolling up leaves, within the folds of which to live, is carried on by many larvæ, which commence their labours soon after exclusion from the egg; with singular address and wonderful precision they conduct the operation, and fold the leaf so neatly that it is to be doubted whether the most adroit manipulation of the human hand could be more successful. We must remember that the leaf is often tough and elastic, and we have been surprised on considering the degree of strength which the little creature must have put forth.

Among these leaf-rollers is the caterpillar of a small but pretty moth of a chocolate colour, termed the Lilac-moth (Lozotænia, Stephens), from depositing its eggs on that shrub. In every garden where the lilac grows this insect and its caterpillars are to be found; our own garden has this summer afforded us the opportunity of observing numbers. The moth also lays its eggs on the currant-bush, but not in preference, and, whether on this or the lilac, always deposits one egg only on a single leaf. No sooner is the egg hatched and the caterpillar has assumed the power of its limbs, while only a few lines in length, than it sets about securing itself from enemies. It commences by fixing several threads to the apical edge of the leaf, and securing the other ends to a higher spot; this done, it strains by means of its limbs at the threads in succession, so as to draw up the edge of the leaf, and being seated about halfway between the two fixed ends of the lines, it there fixes them by glueing them down, thereby shortening the portion of the lines bearing the stress of the leaf; another series of lines is now laid down from the turned up part, fixed, strained, and shortened as before; and in this way the labourer perseveringly proceeds until it has completed a cylinder with many folds, and well secured it with silk. In this it lives, feeding upon the inner layers: afterwards, the caterpillar having increased, it resumes its labours, and ends at last by rolling the whole leaf completely up, leaving only one end of the cylinder open. Fig. 3550 represents the Lilac-tree moth; and Fig. 3551 the half-rolled-up leaf of one of its caterpillars.

The caterpillar of an allied species of moth (Lozotænia ribeana) folds up the leaf of the lilac, rather than rolls it, by fastening lines from one side to the other, and to the central longitudinal nervure; these lines it pulls and shortens in the same manner as the preceding, till at length they are glued together, forming a chamber within. (Fig. 3552, the leaf-nest of this species.)

A small green moth, called the Oak-moth (Tortrix viridana), lays her eggs on the leaves of the oak, which the caterpillars fold up much in the manner of the lilac leaf-rollers. In this instance, however, the caterpillar works on the under, not the upper surface of the leaf, and consequently reverses the turns of the folds. In this, as in the case of the lilac leaf-rollers, the caterpillar lives singly in the cylinder or long chamber thus made, and undergoes all its changes. It appears as a perfect insect in June, and where oak-trees are common is extremely abundant. Fig. 3553 represents the oak-moth; and Fig. 3554 the caterpillars, and the mode in which they fold the oak-leaf.

These caterpillars, whether oak leaf-rollers or lilac leaf-rollers, give us but little annoyance; not so the caterpillar of a little moth (Lozotænia rosana) which sadly injures the rose-tree: during the spring of the present year, 1844, we had the mortification of seeing our own rose-trees, when the leaves were beginning to unfold, bound together in masses by this voracious pest; and as they generally include the germ of a blossom in the bundle of leaves which they draw together, and on which they feast, the bud is quickly destroyed.

The leaf-rolling caterpillar of another species of moth is common on the nettle, and white dead-nettle (Lamium album), the leaves of which it doubles and secures. Fig 3555 shows the leaf of the nettle folded into a nest by this caterpillar.

Among other caterpillars which employ their silk as cordage in binding up the leaves of plants into rolls is one of minute size which feeds upon the sorrel. To effect its purpose it first cuts into the edge of the sorrel-leaf, making an angular piece, which, much in the manner already detailed, it gradually rolls up by successive series of threads, till of the portion thus acted upon it makes an elevated cylinder in which to take up its abode. Fig. 3556 represents this caterpillar at work upon the sorrel-leaf, and the appearance of its domicile.

The caterpillars of the Painted Lady butterfly (Cynthia Cardui) and of the Admirable (Vanessa atalanta) are leaf-rollers, as is also the caterpillar of a butterfly, the Hesperia malvæ, not indigenous in our island. Of this latter species the larva feeds on the mallow, and, previously to assuming the pupa state, it fixes on a leaf, which it gradually rolls up, so completely and skilfully as to form an egg-shaped dwelling; within this it undergoes its last metamorphosis. Fig. 3557 shows the nests of the Hesperia malvæ, with the caterpillar, pupa, and perfect butterfly.

There is a species of moth, the Tortrix chlorana, not uncommon, of which the caterpillar unites into a bundle several of the long slender leaves of the ozier, binding them together by bands of silken threads, which are regularly and neatly applied. In the centre of these leaves it dwells secure from enemies; where the leaves assume the form of double longitudinal rolls or columns, as is sometimes the case before they become fully developed, the caterpillar binds them into a sheaf-like bundle the appearance is very pretty, and reminds one of a fluted column, or—

"Bundles of lances which garlands had bound."

Fig. 3558 shows, at *a*, the ordinary nest of the Tortrix chlorana, and, at *b*, a portion of a nest composed of curled-up leaves.

There is another singular caterpillar, called from its singular attitudes the Zigzag, which weaves together with threads of silk the leaves of the willow or ozier, and forms for itself a snug bower in which it dwells surrounded by abundance of food. In this it undergoes its transformations; the perfect moth, Notodonta ziczac, making its appearance in the ensuing spring. Fig. 3559 shows this caterpillar and its nest of ozier-leaves.

On the cypress-spurge (Euphorbia Cyparissias), a woodland plant, but by no means of common occurrence, a caterpillar (Acronycta Euphrasiæ) thinly tufted with hair may be found towards the end of October, within a singular cocoon or dwelling made of the narrow grass-like leaves of the plant, which are first detached, then secured in regular succession and orderly arrangement on the stem, and ultimately bent till the two ends approximate and are fixed. In this manner a sort of oval nest is produced, having a very neat and compact appearance. Fig. 3560 shows the cypress-spurge caterpillar and its nest.

A singular nest is made by a smooth bluish caterpillar of small size (Bryophila perla) which frequents old walls, feeding on minute mosses and lichens. It binds together into a circular nest fragments of green moss, detached with a little earth adhering to the root; with these it builds a cell with the moss outside and the earth within, and so neatly is the whole put together that it might be mistaken for one of those elevated rounded or oval tufts of moss which we often see growing on walls or mouldering brickwork. When these caterpillars are shut up in a box and supplied with moss destitute of earth, they construct cells in the form of a hollow ball, most skilfully interweaving and working up the materials. Fig. 3561 shows the moss-cell and caterpillar of the Bryophila perla.

We might go on to multiply examples of the uses to which caterpillars apply their silk, but we have sufficiently illustrated this part of our subject. Let us then return to the caterpillar itself, restricting our present observations to the Lepidoptera. We have said that caterpillars shed their skin in order to grow: it is curious to see how on the new skin all the hairs and spines, in such as are furnished with these appendages, have been prepared for the approaching crisis; they are all folded down in separate tufts, those of the three first rings directed to the head, those of the succeeding limbs towards the caudal extremity. These tufts are moistened with a fluid secretion, and look like small camel's-hair pencils dipped in water and squeezed partially dry. Fig. 3562 shows the moulting of caterpillars: *a a*, a caterpillar magnified; *b b*, the same when it has just cast its skin, the tufts of hair still moist; *c*, the same, natural size; *d e f g*, tufts of its hairs, magnified; *h*, leg and foot, magnified; *i*, the caterpillar breaking through the old skin; *k k*, hairy caterpillar of the sycamore.

Let us now pass on to a cursory review of the pupa, or chrysalis, which in most instances bears a very different appearance to the perfect insect that is to be, or the previous caterpillar. A great change in the system has already taken place, and is still in progress: some organs are evolving, others are becoming modified, and others lost; the horny jaws of the voracious caterpillars of the Lepidoptera are to be succeeded by a tubular proboscis; the wings are to become developed, the limbs elongated, the pro-legs lost, the three segments forming the thorax are to be consolidated, and the nervous and digestive apparatus greatly modified. Often, indeed, the chrysalis or pupa shows beneath the outer case, which is to be soon thrown off, the limbs and wings, the antennæ and proboscis, all nicely arranged and in preparation as it were for the time in which the prison is to be opened and the inmate set free.

Fig. 3563 represents three pupæ: *a*, the pupa of a sphinx; *b*, the pupa of a butterfly; *c*, the pupa of a beetle. In these it will be seen that the wings, eyes, antennæ, &c. are to be easily traced, and the stigmata or breathing orifices down the side are very distinct.

Fig. 3564 represents also three pupæ: *a*, the chrysalis of the Gonopteryx Rhamni; *b*, the pupa of Laria fascelina; *c*, the pupa of Sphinx Ligustri. In all these examples the pupæ are quiescent, but are capable of moving the ringed portion of their bodies, and evidently are susceptible of feeling, as they wriggle when touched. They breathe without

a doubt, as the experiments of Réaumur and De Geer satisfactorily prove; and in some instances, if not in all, the mouths of the spiracles are furnished with ciliary valves, which are closed immediately if the pupa be immerged in water, but open when it is taken out.

Fig. 3565 shows the structure of this apparatus: *a* is the mouth of a spiracle with the valve open; *b*, the same with the valve shut.

We need scarcely say that far more definitely than in the caterpillar the parts of the perfect insect can be demonstrated in the pupa, even where they are not manifest externally. In the moths and butterflies the insect inclosed in the pupa-case is very palpable. Fig. 3566 represents the leaf-like Lappet-moth (Gastropacha quercifolia): *a*, the pupa removed from the cocoon; *b*, the moth seen on the under side with its feet folded up; *c*, a side view of the same.

The pupa has a close resemblance to an Egyptian mummy in its inner case; the feet are folded over the breast, and the wings, which in the perfect insect are so ample, are compressed into a small compass, and these and the antennæ have all their respective sheaths. The haustellum of this moth is in a rudimentary state, but the palpi project horn-like from the forehead. In the beautiful peacock-butterfly, of which the caterpillars are abundant on the nettle, the chrysalis is angular; two angular points encase the eyes, while the wings lie beneath four lateral angles, of which the uppermost on each side forms a sort of shoulder. The limbs, the antennæ, and the sucker or haustellum run longitudinally down the breast. If a pupa in an advanced stage be selected, the thin membranous pupa-case may be removed by careful management, and the different members traced out with little difficulty. The wings will be found soft, crumpled, and humid, and the powdery down of fine scales which covers them will be scarcely visible, nor will the rich colouring be displayed. Already, however, are the limbs firm and capable of being moved about, the proboscis capable of being curled up, and the antennæ of being put into action.

Fig. 3567 shows—*a*, the under side of the chrysalis of the peacock-butterfly; *b*, the wings, and antennæ traced out from the same; *c*, the perfect insect, Vanessa Io, fully developed.

The period at which pupæ come to maturity is no doubt greatly influenced by temperature, though in all probability there are other circumstances which operate in hastening or retarding the process.

At first the body is almost liquid or of a soft and pulpy consistence, and consolidation and firmness are gradually acquired. According to Swammerdam these results are effected by evaporation; and in accordance with this view Kirby and Spence observe that "it is quite plain that this necessary transpiration, other circumstances being alike, must take place sooner in a small than a large pupa. Since the more speedy or more tardy evaporation of fluids depends upon their exposure to a greater or less degree of heat, we might, *à priori*, conclude that pupæ exposed to a high temperature would sooner attain maturity, even though larger in bulk, than others exposed to a low one; and this is the fact. The pupa of a large moth which has assumed that stage in the early part of summer will often disclose the perfect insect in twelve or fourteen days; while that of the ichneumon, not one hundredth part of its size, that did not enter this state till late in the autumn, will not appear as a fly for seven or eight months. But this is not the whole. The very same insect, according as it has become a pupa at an earlier or later period of the year, will at one time live but a few weeks, at another several months in that state."

Réaumur pursued a series of experiments by subjecting the pupæ of different butterflies and other insects to different degrees of heat and of cold, and found that in the hothouses of Paris he could cause in some the development of the perfect insect in ten or twelve days during the middle of winter, and in others in three, four, five, or six weeks; and that the butterflies were healthy and laid eggs. On the contrary, he found that he could prevent pupæ that would naturally appear as perfect insects in July, from undergoing any change, by placing them in unnaturally cold situations. Some pupæ, formed in August, 1733, he kept thus torpid from January throughout the summer and autumn of 1734, and still on to August, 1735; and though they were living and healthy, they had not undergone their transformation. These and many other experiments certainly demonstrate the fact that the change of the pupa is accelerated by warmth and retarded by heat; but though the pupa may exhale vapour from its spiracles, we cannot see how evaporation is to effect a perfection of parts which in all other animals results from vital operations. We repeat, that we know not how evaporation can complete the changes which the vital powers of the system have been carrying forward. Moreover, though we admit the effects of temperature, yet temperature alone will not produce uniform effects. We are informed by Mr. Marsham ('Linn. Trans.' vol. x.), that Mr. Jones of Chelsea in one of his excursions captured a female specimen of the spotted muslin-moth (Diaphora mendica), which laid a number of eggs. From these he procured thirty-six caterpillars, which he fed till they spun their cocoons and became pupæ; all were exposed to the same temperature, but at the usual season only a third of them produced moths, and he concluded that the rest were dead: but the second season, twelve more moths to his astonishment made their appearance; and the remaining twelve became evolved the third season, and were active and healthy. The same circumstance has been observed in the instance of other pupæ.

The exit of an insect from its pupa case is a most interesting spectacle, and one which every person has the opportunity of witnessing. Immediately previous to this event, the frame of the pupa seems convulsed, and the pulsation of the dorsal vessel quickened; it is now easy to perceive that the enclosed insect, say a butterfly, is freeing itself within its ease, or puparium; it presses forwards and a cleft is made in the back near the head, and through the aperture emerges the liberated butterfly. The antennæ and limbs are drawn out of their cases; the wings are crumpled, wet, and soft, of a thick substance, and capable of being stretched out, which cannot be done with the wings when perfect and hardened. Awhile it rests, as if exhausted, but soon the fluids are violently agitated and impelled through the wings, air from the respiratory apparatus rushes down the tubular nervures, the limbs are in motion, the wings quiver and become extended, as they yield to the impetus of the aerial and circulating fluids; their wrinkles vanish more and more, and the colours, spots, and markings develop and strengthen, displaying their elegant arrangement and brilliancy of tone. In about half an hour the recently wet and drooping wings have acquired their due firmness and expansion; and now, fanning the sunny air, it fearlessly commits itself to an untried element; disdaining the coarse herbage on which it had formerly fed, it seeks the flowers and sips their honied sweets.

Instances of deformity in insects are not of rare occurrence. From injuries received by the caterpillar or pupa, and sometimes, perhaps, from original malformation, one or more or all the wings never become expanded, and the insect remains a cripple, scarcely able or even not able to fly; exclusive therefore of accidents to which it must be peculiarly liable, privation of food soon terminates its existence. Fig. 3568 represents a specimen of the small tortoise-shell butterfly: *a* (Vanessa Urticæ), with one wing imperfect; *b*, the brown-tail moth (Porthesia auriflua), with shrivelled wings; and *c*, (Vanessa Urticæ), with unexpanded wings.

From the caterpillars and pupæ of the Lepidoptera let us turn to those of other insects, many of which are very interesting.

The larvæ or maggots of flies (Muscidæ), unlike those of most insects, never change their skin; they suffer no moult, not even when they assume the pupa state. If we take the maggot of the common blow-fly (Musca vomitoria) as an example, we shall find that having attained to a proper development without any moult, it leaves the putrescent animal matter on which it has been feeding, and buries itself a few inches deep in the soft earth; here it becomes contracted in length, increased in circumference, hard, firm, and tough, with skin like thin parchment, and of a dull red; it is now in its pupa state, and resembles in form an elongated oval. When the perfect fly escapes from this envelope, it leaves behind the mandibles it possessed while a caterpillar, and which are no longer needed; they remain in the inside of the puparium.

Fig. 3569 represents—*a*, the pupa of the blow-fly; *b*, the same, magnified; *c*, the head of the pupa, opened to show the cast mandibles; *d*, the pupa of a two-winged fly (Syrphus). Fig. 3570 shows—*a*, the newly-hatched blow-fly, magnified, with the wings crumpled, wet, and pulpy; and *b*, the same with the wings dry and fully expanded.

The larva of the Syrphus (Fig. 3571, the perfect insect) feeds upon aphides, which it destroys in great numbers; unlike the larva of the blow-fly, it does not when about to become a pupa bury itself in the earth, but applies by means of its mouth a drop of tenacious gluten to a leaf or twig, and on this presses down its body, which soon becomes immoveably fixed, and assumes the pupa state. The larva is destitute of eyes, and, as Kirby says, it fixes itself by its tail and gropes about on every side till it comes in contact with an aphis; this it instantly transfixes with a sort of trident or three-pronged retractile organ; and elevating it, so as not to be disturbed by the victim's struggles, soon devours it.

The larvæ of the lace-winged flies (Hemerobius) are still more destructive to aphides. They are active, and armed with two crescent-shaped jaws which are tubular; these they plunge into the body of the aphis, and through them imbibe its juices, leaving nothing but a withered skin. Nothing can be more dissimilar in appearance than the delicate fluttering lace-winged Hemerobius and its voracious larva.

Fig. 3572 represents—*a*, the Hemerobius, or lace-winged fly; *b*, the larva of the same, magnified; *c*, syrphus; *d*, the larva of syrphus devouring the aphides of the elder; *e*, the head, magnified to show the mouth.

Among larvæ remarkable for their habits may be noticed the ant-lion, or larva of a neuropterous fly, Myrmeleon formicarium, allied to the dragon-flies.

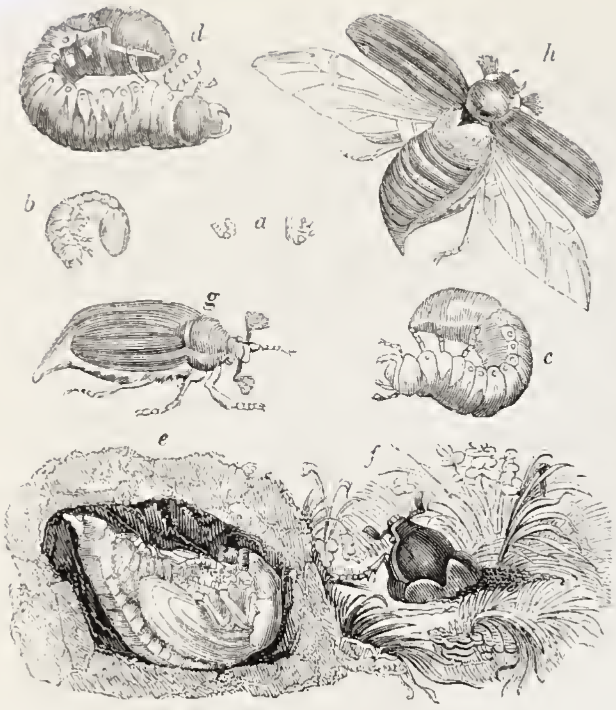
The larva is of a depressed form and grey colour, not much unlike a woodlouse in general aspect, but larger and more triangular; it has six legs, and a pair of formidable jaws, resembling a pair of calliper compasses, and these are perforated and tubular, being adapted for seizing ants, upon which it chiefly preys, and imbibing their juices. It is slow and retrograde in its movements, always walking backwards; but its slowness is more than counterbalanced by the cunning and artful plan it adopts in order to secure its victims. This larva is found in sandy places, where the sand is fine, and though not known to exist in England, is common in some parts of France. Mr. J. O. Westwood observed it in the Parc de Belle-Vue near Paris, where its cells were at the foot of a very high bank of exceedingly fine sand. It is in such sand that it constructs a funnel-shaped pitfall, at the bottom of which it lies motionless, in wait for its prey, covered entirely with sand, excepting the jaws, which are exposed and spread open on the sand, so as to be scarcely visible. Here then it lies in wait for its prey. If alarmed, says Mr. Westwood, it takes a step backwards, burying the jaws; "but when an insect falls into the hole, the jaws are instinctively and instantaneously closed, and the insect seized by the legs, wing, or body, just as it may chance to fall within the reach of the ant-lion's jaws. If, however, the insect be not seized, but attempts to escape, no matter in what direction, the ant-lion immediately begins twisting its head about, and shovelling up the sand with the greatest agility, jerking it about on each side and backwards (but never forwards, as misrepresented in some figures), until the hole is made so much deeper, and such a disturbance caused on the sides of the hole, that the insect is almost sure to be brought down to the bottom, when it is seized by the ant-lion; which immediately endeavours to draw it beneath the sand; if it be very boisterous, the ant-lion beats it about, firmly holding it with its jaws, until it is too weak for further resistance. Hence as the head of the ant-lion is immersed in the sand, it is evident that the accounts given in popular works of the instinct by which it throws the sand exactly in the direction of the escaping prey are not quite correct; the act of throwing up the sand, when an insect has fallen into the pit, and attempts to escape, having evidently for its chief object that of making the pit deeper, and more conical, and therefore more difficult of ascent." Its mode of making this trap is as follows:—closing its jaws, its forms them into a kind of shovel, the sharp edges of which it thrusts laterally into the sand on each side of the head, and then with a jerk dislodges the sand, and thus it proceeds till the cavity is excavated. When moving from place to place, it works its way in a spiral direction, pushing itself backwards and downwards into the sand, the head being carried horizontally and the back much arched; in this manner, mole-like, it travels, forming little mole-hills in the sand, where its jaws are seen emerging. "It does not," says Mr. Westwood, "appear to me that this retrograde motion has anything to do with the actual formation of the cell, since, as soon as it has fixed upon a spot for its retreat, it commences throwing up the sand with the back of its head, jerking the sand either behind its back or on one or the other side." The ant-lion therefore burrows, as well as makes pits. When about to assume a pupa condition, it constructs a globular cocoon of fine sand, lining it with silk, and in about three weeks the perfect insect emerges.

Fig. 3573 represents the larva of the ant-lion, magnified, with a perfect trap. The larva is also shown in the act of descending into the sand. Fig. 3574 shows the ant-lion's pitfall in an experimenting box.

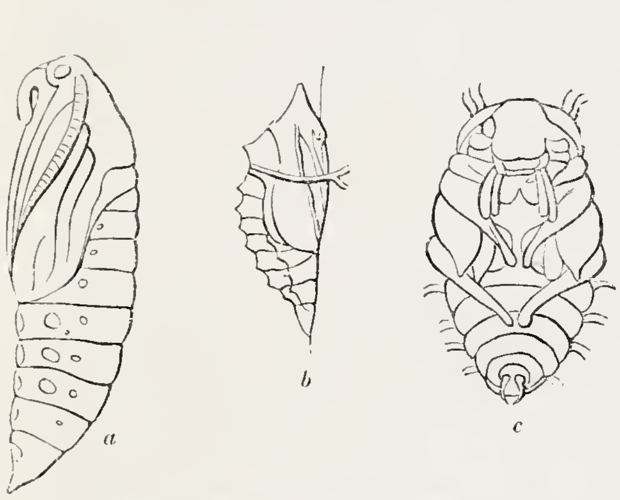
Fig. 3575 represents—*a*, the perfect insect, Myrmeleon formicarium; *b*, the head, magnified to show the calliper-formed mandibles; *c*, the pupa; *d*, the pupa escaping from its cocoon.

We have said nothing hitherto respecting the changes which the larvæ of coleopterous insects undergo, and we now adduce a few examples, upon which to offer some remarks.

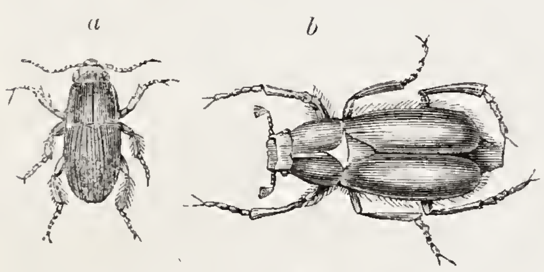
The larvæ of the Coleoptera differ from each other in form and habits, as do the perfect insects; and some of them are greatly injurious, and perhaps none in our island more so than those of the chaffer-beetle, Melolontha vulgaris, a common but hand-



3576.—Transformations of Cockchafer

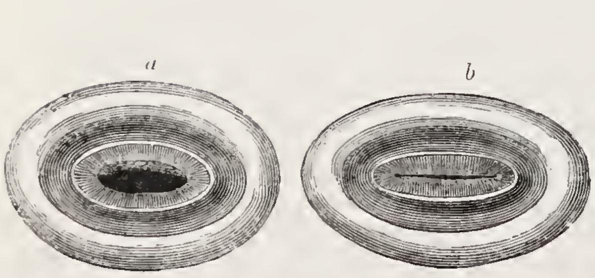


3563.—Pupæ of Sphynx, Butterfly, and Beetle.

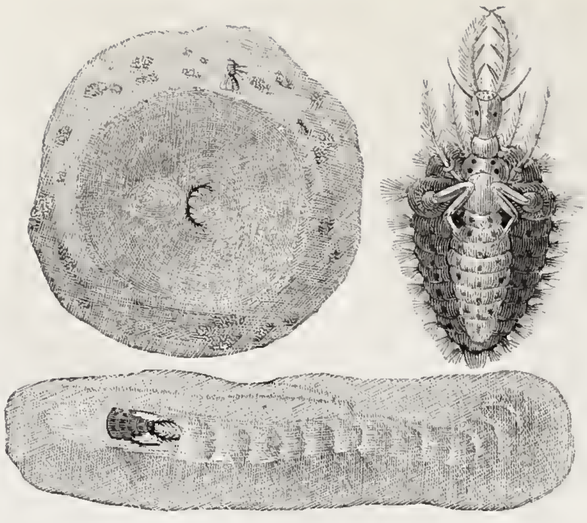


3577.—Labrus gibbus and Melolontha ruficornis.

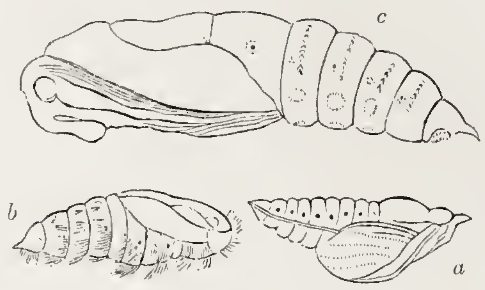
3575.—Ant-lion and Pupa.



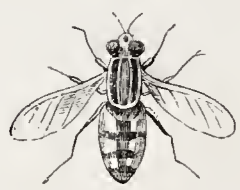
3565.—Spiracles of Pupæ.



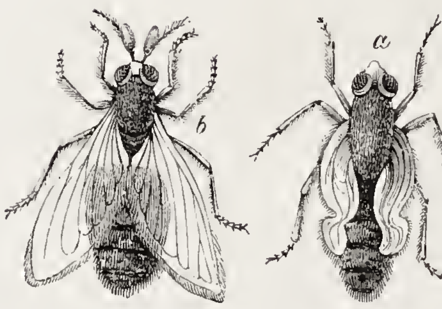
3573.—Larva of Ant-lion and Pit.



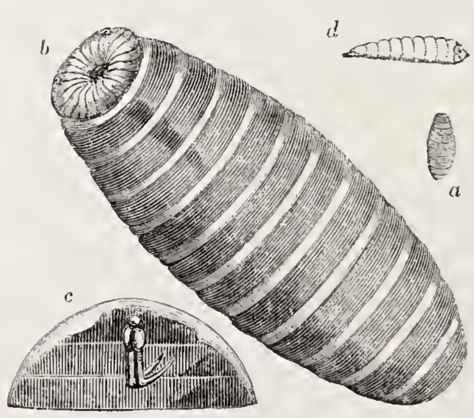
3564.—Pupæ.



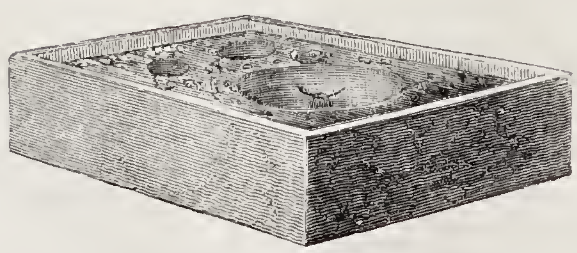
3571.—Syrphus.



3570.—Newly-hatched Blow-fly.

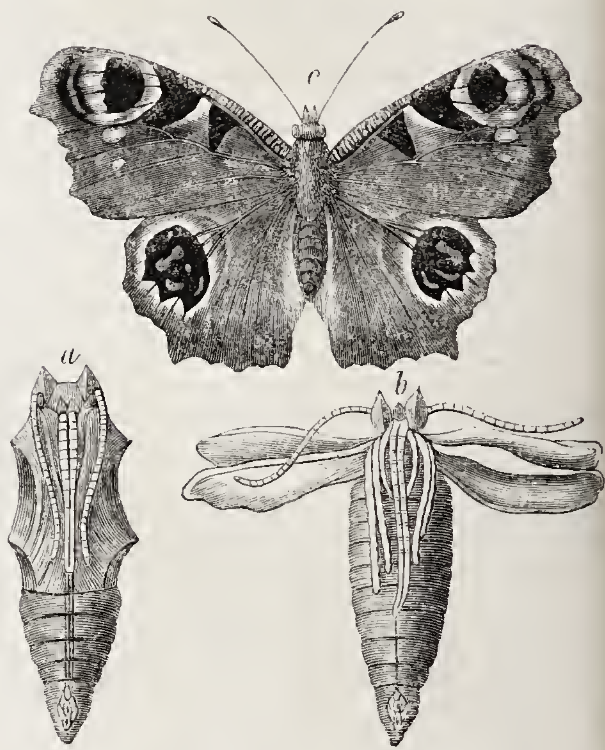


3569.—Pupa of Blow-fly.

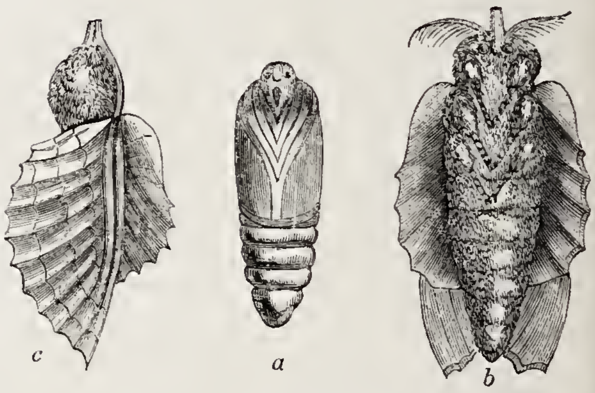


3574.—Ant-lion and Pit in Box.

3568.—Butterflies with Imperfect Wings.

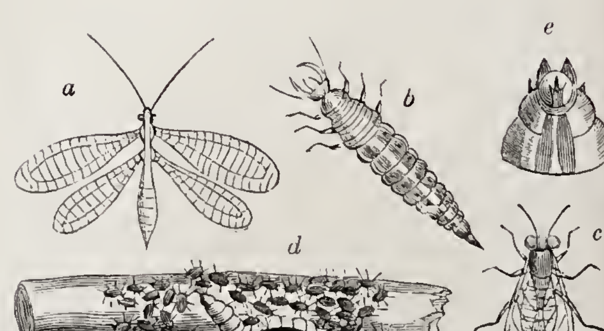


3567.—Peacock-Butterfly and Chrysalis.

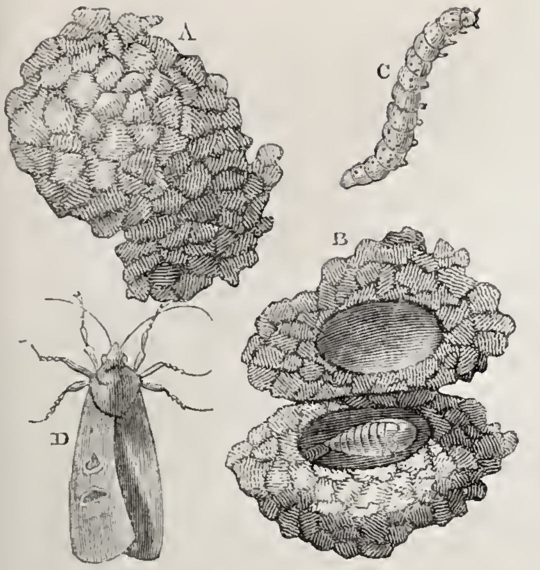


3566.—Lappet-Moth.

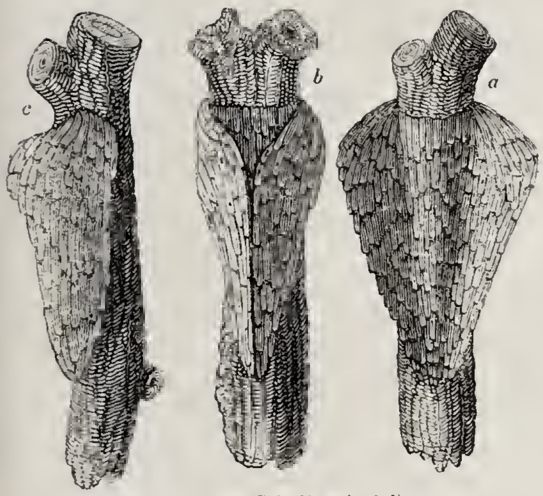
3578.—Wire-worm and Click-Beetle.



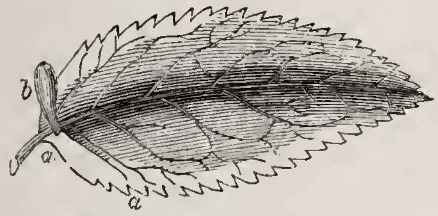
3572.—Lace-winged Fly, Syrphus, and Larvæ.



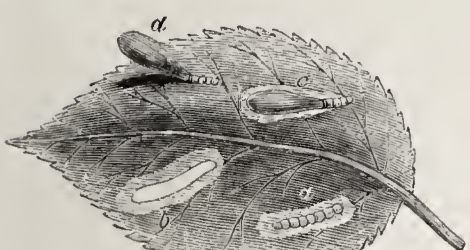
3589.—Earth-mason Moth, Caterpillar, and Nest.



3587.—Cells of Spiralis strigulalis.

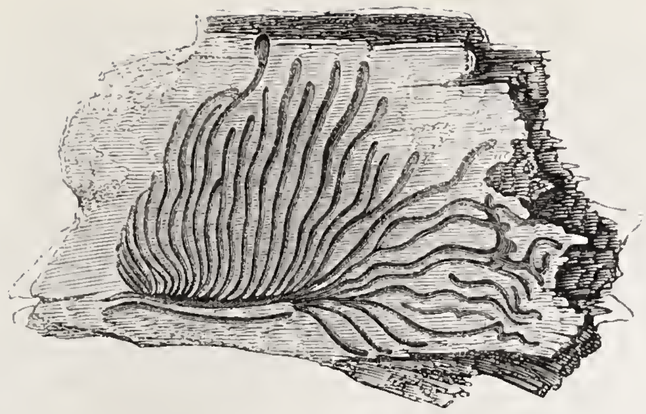


3592.—Caterpillar's Case on Elm-leaf.

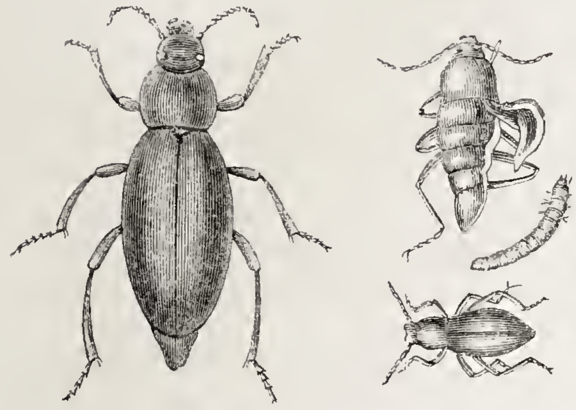


3593.—Caterpillar forming Case.

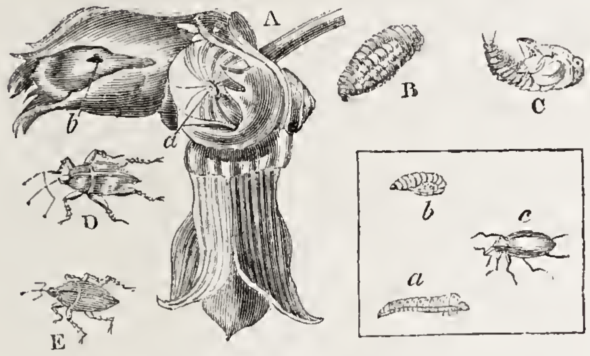
3594.—Caterpillars and Tents.



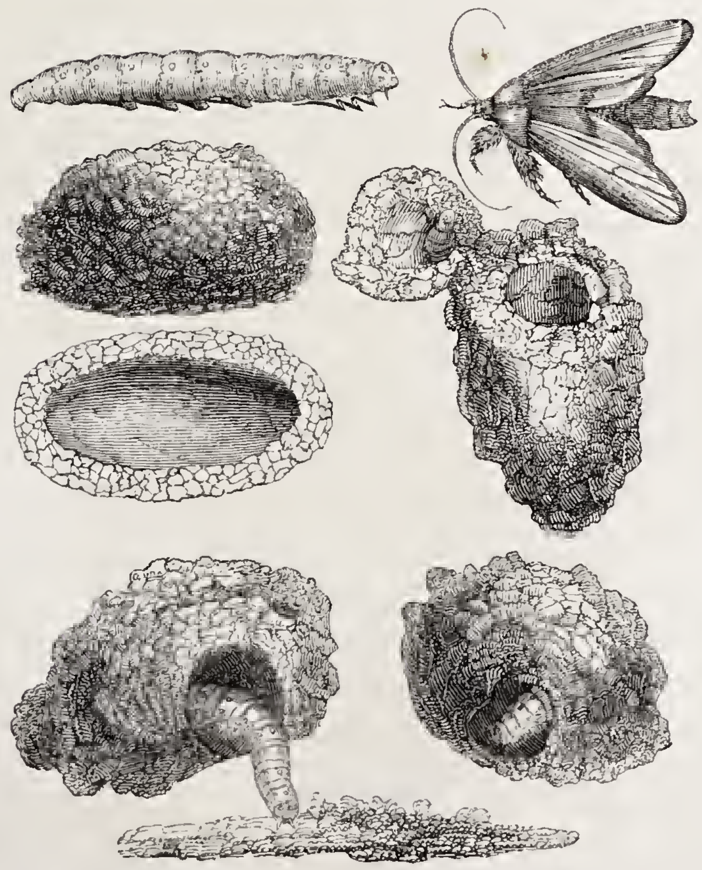
3583.—Bark mined by Beetle-grubs.



3580.—Churchyard-Beetle and Grub.

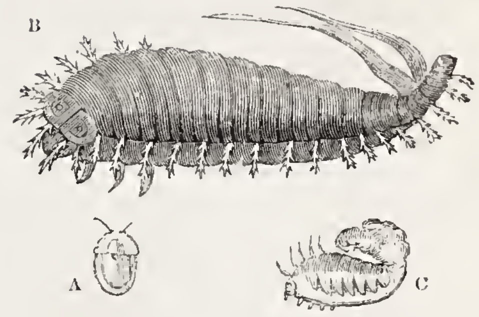


3581.—Nut and Apple-tree Weevils.



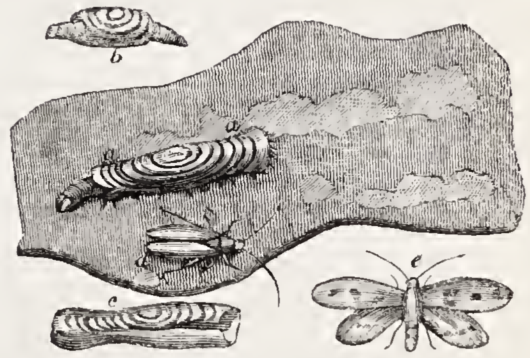
3590.—Earth-mason Moth, Caterpillars, and Nests.

3586.—Spit Frog-hopper and Larva.



3585.—Green Tortoise-Beetle and Grub.

3582.—Corn Weevil.



3591.—Clothes-Moth and Caterpillar.

3579.—Meal-worm and Tenebrio molitor.

3588.—Nests of Earth-mason Caterpillars.

some lamellicorn beetle. The female chaffer, when about to lay her eggs, digs into the soft earth of a meadow or corn-field to the depth of four or five inches, and at the bottom of this excavation she deposits them in a cluster to the amount of some hundreds; they are of an oval shape and yellow colour. Towards autumn these are hatched, and the grubs soon increase in size, feeding on the roots of grasses, wheat, and other herbage; on the approach of winter they burrow deep into the earth, and there become torpid till the return of spring. Restored to activity by the genial warmth, they recommence their depredations, and often is a whole field of young wheat entirely despoiled, while the blame is laid on the poor rooks, who endeavour to extirpate them and really work for man's benefit; for, though they may tear up a few roots of wheat in their endeavours to get at the grubs, the whole amount of the mischief done is very trifling. The larvæ now grow rapidly, and change their skin three or four times, burrowing for the purpose a deep retreat, where they may lie undisturbed; with a renewed skin they acquire a renewed appetite, and continue their devastations. Winter comes, and again they burrow deep, and become torpid till the spring, and so on till the autumn of the third year after exclusion from the egg. During this autumn they descend to the depth of about three feet into the earth, and there assume the pupa condition; and in the following spring the perfect beetle is disclosed. It is at first soft and feeble, and it is not until after the lapse of a fortnight that it has acquired its due hardness and colour. In May it creeps forth, and myriads sometimes suddenly make their appearance, flying about in all directions, or covering the opening foliage of the oak or sycamore. Nor is the beetle less voracious than the larva; it devours the leaves of the trees, often entirely stripping them of their verdure.

Fig. 3576 represents the transformations of this beetle: *a*, newly hatched larvæ; *b*, a grub, one year old; *c*, the same, in the second year of its growth; *d*, the same, three years old (the lateral spiracles are in these very perceptible); *e*, the pupa in its underground cell: *f*, the chaffer emerging from the earth; *g*, the perfect insect; *h*, the same on the wing.

The grub of an allied beetle (Melolontha sostitialis; Zantheumia solstitialis, Leach) is often very injurious in fields and gardens; the perfect insect is smaller than the chaffer, and does not appear till midsummer. The grub of the Melolontha ruficornis is also destructive to wheat, and the same effects have been attributed to the larva of a carnivorous beetle, Labrus gibbus, which, according to Germar and other members of the Society of Natural History at Halle, committed great havoc in 1813; but it is remarkable, that with these larvæ were found the grubs of the Melolontha ruficornis in considerable numbers; and it is not improbable that the mischief is to be attributed to the latter, while the former made them their prey. Moreover it has been said that the perfect insects of Labrus gibbus ascend the stems of wheat at night, to get at the grains in the ear. Mr. Stephen suggests that they ascend for the purpose of devouring the parasitic insects of the wheat, and not the grain, which their prey in reality destroyed.

Fig. 3577 represents—*a*, Labrus gibbus; *b*, Melolontha ruficornis.

There is a whitish slender grub, very tough, and hard, which abounds often in gardens and fields, where it lives in the earth, devouring the roots of various plants, as wheat, and grass, potatoes, carrots, turnips, and other culinary plants, and is extremely partial to the French-bean. It is popularly known as the wire-worm, and is the larva of one of the click-beetles (Elater segetis, Linn.). It continues for five years before assuming the pupa state. It is particularly partial to land newly broken up, and is very common, and proves a great pest in gardens newly reclaimed from meadow-land. Fig. 3578 shows—*a*, the wire-worm; *b*, the click-beetle. A luminous species in the West Indies (Elater noctilucus) is exceedingly destructive to the sugar-cane, on the roots of which the grub luxuriates, to the destruction of the plants.

Most are well acquainted with the meal-worm, a larva which commits extensive ravages not only on flour, but which also attacks bread, biscuit, and other farinaceous preparations. It is the larva of a beetle, the Tenebrio molitor, Linn., and exists in that condition for two years previous to its final change. The meal-worm has, it is said, been sometimes swallowed accidentally, and has produced considerable disorder; this however is not very probable; the action of the gastric juice and of other agents would soon destroy it. Fig. 3579 represents the meal-worm and the beetle Tenebrio molitor.

That some insects taken into the stomach in their early state, either just emerged from the egg or as yet undeveloped from the egg, occasionally continue to exist and thrive there, producing distressing effects, medical records sufficiently prove. Among the best authenticated cases is that recorded in the 'Dublin Trans. of Assoc. Phys. in Ireland,' 1824 and 1828, by Dr. Pickells of Cork. Not having the 'Transactions' at hand, we transcribe the following summary from the pen of a well-known naturalist:—"Mary Riordan, aged 28, had been much affected by the death of her mother, and at one time of her visits to the grave seems to have partially lost her senses, having been found lying there on the morning of a winter's day, and having been exposed to heavy rain during the night. When she was about fifteen, two popular Catholic priests died, and she was told by some old woman that if she would drink daily for a certain time a quantity of water mixed with clay taken from their graves, she would be for ever secure from disease and sin. Following this absurd and disgusting prescription, she took from time to time large quantities of the draught: for some time afterwards, being affected with a burning pain in the stomach, she began to eat large pieces of chalk, which she sometimes also mixed with water and drank. Now whether in any or all of these draughts she swallowed the eggs of insects cannot be affirmed, but for several years she continued to throw up incredible numbers of grubs and maggots, chiefly of the churchyard beetle (Blaps mortisaga). 'Of the larvæ of the beetle (says Dr. Pickells), I am sure I considerably underrate when I say that not less than seven hundred have been thrown up from the stomach at different times since the commencement of my attendance. A great proportion were destroyed by herself to avoid publicity; many too escaped immediately by running into holes in the floor. Upwards of ninety were submitted to Dr. Thompson's examination, nearly all of which, including two of the specimens of the meal-worm (Tenebrio molitor), I saw myself thrown up at different times. The average size was about an inch and a half in length, and four lines and a half in girth.' Altogether Dr. Pickells saw two thousand grubs of the churchyard-beetle (excluding those of other insects), and there were many which he did not see. Mr. Clear, an intelligent entomologist of Cork, kept some of them alive for more than twelve months." It would appear that there were larvæ of a dipterous insect, which, according to her own account, were alive and moving almost literally in myriads. "Mr. S. Cooper cannot understand whence the continued supply of grubs was provided, seeing that larvæ do not propagate; but the simple fact that most beetles live several years in a state of larvæ sufficiently accounts for this. Their existing and thriving in the stomach will appear less wonderful from the fact that it is exceedingly difficult to kill this insect (Blaps mortisaga), for Mr. Henry Baker repeatedly plunged one into spirits of wine, so fatal to most insects, but it revived even after being immersed a whole night, and afterwards lived three years." Fig 3580 represents the churchyard-beetle (Blaps mortisaga), in the grub and perfect state.

From this account it appears that the meal-worm may live in the human stomach, but it can be only under peculiar circumstances; and indeed the whole case narrated above is extraordinary.

There is a group of beetles termed weevils, the larvæ of which are very injurious, some to fruits of various kinds, others to grain. The adult beetles are furnished with long slender horny beaks, which are efficient instruments. One species, the nut-weevil (Balaninus Nucum), drills by means of the beak, which carries the jaws at its extremity, a hole in the nut of the filbert or hazel, while young and in its soft state, that is, about the beginning of August. Into this orifice, rejecting a nut previously pierced, the female introduces a single egg, which is hatched in about a fortnight; on the kernel the caterpillar feeds, and when the nut falls to the ground in September or October, it makes its escape by the orifice, which it probably enlarges, and burrows into the earth, there remaining throughout the winter and spring, the pupa state being assumed in June, and the perfect insect making its appearance in August.

Several species of weevil are destructive to the apple: of these, one, of small size and red colour (Anthonomus pomorum, Germar), may be seen in autumn traversing the branches of apples-trees; it perforates the germinating bloom-buds and in the perforations lays its eggs. In spring these eggs become hatched, and the larvæ feed on the petals and draw up by silken threads the unfolding flower into a cluster. The blossom soon perishes, the fruit-germ is destroyed, and the grub seeks the earth, where it assumes a pupa state, appearing in autumn as a perfect insect to act the part of its parent. Fig. 3581 represents the nut and apple-tree weevils. A, a branch of the filbert-tree; *a*, the perforation in the soft nut; *b*, the orifice through which the larva has escaped: B, the larva of the nut-weevil: C, the same in the pupa state: D, the female weevil: E, the male; *c*, the weevil that deposits its eggs in the apple-tree buds; *a*, the larva of the same; *b*, the pupa.

Among the weevils, or Curculionidæ, which annoy us by their injuries, is the grain-weevil (Calandria granaria), abundant in granaries, storehouses of malt, and similar places. The ravages made by the larvæ of this species are most extensive, and as Kirby and Spence calculate that in one season a single pair of these weevils may produce six thousand descendants, it is not without reason that Virgil wrote—

> "populatque ingentem farris acervum
> Curculio."—*Georg.* i. 185.

Fig. 3582 represents the perfect corn-weevil (Calandra granaria, Clairv.; Curculio granarius, Linn.), magnified.

Fig. 3583 represents the under surface of a portion of the bark of a dead tree furrowed by the larvæ of the Scolytus Destructor, a beetle which deposits its eggs in a group in a hole or crevice of the bark; when the young are hatched, they commence their operations, each taking its own course from the common starting-point and gnawing its way as it proceeds, without interfering with the run of its neighbour; for as the larvæ increase in size, and produce a consequent increase in the diameter of the excavation, the galleries diverge, till they ultimately terminate.

The transformations and habits of those pretty little beetles, commonly called lady-birds, so useful in clearing bushes and plants from aphides, may be here noticed. The lady-bird (Coccinella) generally deposits her eggs, to the number of twenty or thirty, upon the leaf of a plant where the aphides abound; and here the young are hatched surrounded by a full supply of provisions for their maintenance. The larva is of an oval figure, annulated and depressed, and well adapted for wandering over the leaves and twigs in quest of its prey. The pupa is suspended from a leaf or branch, to which it is glued, with the head downwards. The belief entertained by some, that the lady-birds and their larvæ feed upon vegetables, is erroneous; they creep about the foliage, and explore the cracks and fissures in the bark, but only for concealment and rest, or in search of their aphis food.

We have already noticed some of the precautionary modes adopted by larvæ for their concealmant, while at the same time they are in a favourable situation for a supply of food, modes in which their silk was found to be of essential service; there are however other plans pursued by larvæ to the same end. The larva, for example, of the golden-eyed fly (Chrysopa perla), already noticed, forms for itself a covering of the dried fragments of the aphides on which it has feasted, and moves about concealed beneath the shroud they form.

The larvæ of several beetles construct a sort of shield for defence and concealment, of their own ejesta, which they pile upon the back for that purpose. Such is the case with the Crioceris merdigera found on liliaceous plants, as Solomon's seal, &c., in May. An allied species, Crioceris cyanella, exhibits the same habits. The larva of another beetle, Cassida equestris, the green tortoise-beetle, usually found on the burdock, has two caudal appendages, constituting a fork, which can be either raised or lowered at pleasure; this fork it loads with the excrementitious ejesta, which form a canopy above the back. The beetle itself is very pretty, with the elytra developed so as to conceal the legs. Fig. 3585 shows—A, the Cassida equestris: B, the grub, magnified so as to display its caudal fork; C, the same, with its strange canopy.

A very singular mode of concealment is that used by the ametabolous larva of the frog-hopper, so common in the bushes of our gardens. The larva of this species, Cercopis spumaria, is very soft and delicate, though the perfect insect, a little creature that leaps with wonderful agility, is covered with hard wing-cases. To defend itself, therefore, from the effects of the sun, and the assaults of other insects and birds, it envelops itself in a quantity of white froth, which it secretes, and in which it may be generally found. It is of a pale green colour, but the perfect insect is brown, with a paler double band and a white spot. This froth is well known to all under the popular name of "cuckoo-spit."

Fig. 3586 shows—*a*, the spit frog-hopper (Cercopis spumaria), flying; *b*, the froth forming a sort of fluid cocoon around the larva.

We shall now proceed to a few miscellaneous observations on the habits of certain caterpillars, and then pass to a consideration of those larvæ that inhabit water and other fluids, for which they are especially modified. There is a caterpillar, supposed to be that of a moth, Spiralis strigulalis, that builds a most ingenious abode on the young branches of the oak; the caterpillar is whitish with a tinge of carmine, and studded with tufts of red hairs. It constructs its cell of rectangular slips of the outer

bark of the young branch, its first procedure being to lay down a somewhat triangular platform, the sides of which extend beyond the twig, and slope obliquely upwards. This being finished, the next thing is to draw the edges of the sides of the platform together, which it does in the same way as many of the leaf-rollers draw the sides of a leaf together, namely, by means of silken cords which they strain till the two edges meet. An opening at the upper part is still left; but this is afterwards closed in a similar manner. When finished, the whole looks like a tumour or excrescence on the bark. Fig. 3587 represents—*a*, the platform of this structure, magnified, before the walls are closed; *b*, the walls closed, excepting at the upper part; *c*, a side view of the structure complete. The caterpillars of many insects construct cells of earth underground, in which they lie torpid in pupa state during the winter, the perfect insect appearing in the spring. They make these cells of pellets of earth, which they moisten and work into a proper consistence, and bind to each other with very fine silken tissue. They work, in completing their cell, from the inside, which they render very smooth and even, generally lining it with silken arras; this they complete when the aperture is finally closed. Such cells are made by the caterpillars of the ghost-moth (Hepialus Humuli), of the water-betony moth (Cucullia Scrophulariæ), and many others.

Fig. 3588 shows the rough outside of these cells of earth. Fig. 3589 shows—A, the exterior of the cell; B, a section disclosing the pupa in a smooth silk-lined chamber; C, the caterpillar; D, the moth. Fig. 3590 shows other nests of earth, with the caterpillar at work, and a section of one, so as to display the smooth inside. The caterpillar and moth are also represented.

There are several small moths of the genus Tinea, termed clothes-moths, fur-moths, cabinet-moths, &c., the caterpillars of which feed on various animal substances, as fur, silk, woollen stuffs, and the like. Some are the plague of museums, despoiling rare skins and the plumage of birds; nay, the very cabinets of insects are subject to their visitations, and often the mischief is not discovered till too late. The moth lays her eggs on the fur, cloth, or other material on which the future caterpillars are to feed, and these on exclusion prepare for themselves a soft investment or cloak, and folded in this they commence their ravages. In order to prepare their tent, they cut hairs, or filaments of wool, or portions of feathers, and bind them together with threads of silk, continuing till a felt-like fabric is made of sufficient size to wrap round the body; this they fold around them, bringing the edges together and securing them with silk. As it grows they both add to the length of this case and to its diameter; in the former instance they work in fresh materials at each end, and if shifted to stuffs of various colours, the tissue will be parti-coloured. In the second instance the caterpillar slits the case, first at one end and then at the other, and works in a strip of the requisite breadth. Fig. 3591 shows the cases of the clothes-moth (Tinea pellionella): *a*, caterpillar feeding in a case which has been lengthened by ovals of different colours; *b*, a case cut at the ends for experiment; *c*, a case partially slit by the caterpillar in order to enlarge its circumference; *d* and *e*, the clothes-moths in their perfect state. There are other caterpillars belonging to this family of moths, which feed upon leaves and vegetable aliment; and these make for themselves a case, which they carry about with them, as a snail does its shell, changing them when necessary. This case is composed of a portion of leaf, not indeed of the whole substance, but of the upper layer or membrane, artfully separated from the lower, and rolled up into the proper form. In order to effect this, it eats through one of the two membranes and gnaws into the parenchyma or pulp between them, which it devours, thus rendering the two membranes, which are very thin, perfectly transparent. Having fashioned a piece of the proper shape and size, it joins the edges, and ultimately disengages the case, and travels along the leaf, with its head and limbs only emerging from its portable domicile. We have seen these abundantly on the leaves of the gooseberry-bush and currant; others are found on the elm, hawthorn, oak, and various fruit-trees. The cases appear erect or nearly so when the caterpillar is not moving or feeding, and the edge of the orifice appears to be glued to the leaf.

Fig. 3592 shows one of these cases on a leaf of the elm—*a a*, the part of the leaf from which the case has been cut out; *b*, the case itself.

Fig. 3593 shows the process in which this tent is formed—*a*, the caterpillar occupying the space it has eaten between the upper and under cuticle of the leaf; *b*, a portion of the upper cuticle cut out for the formation of the case; *c*, the case nearly complete; *d*, the perfectly closed case, with the caterpillar protruding its head.

A still more curious dwelling is made by the minute caterpillars of a small moth, Tinea, which feed on the lichens growing on old walls. The dwelling or case is conical, slightly curved, freely open at the base, and with a small orifice at the apex. It is composed of minute particles of stone, which the caterpillar detaches grain by grain, adding them to the wall of its structure and securing them by silk. To complete one of these houses (in which the caterpillar travels about, without quitting) requires the labour of twenty-four hours. Generally minute portions of green lichen are mingled with the other particles: and the whole structure is beautifully neat. When about to become a pupa the caterpillar becomes stationary and secures its case to the stone by a strong network of silk, and also closes the larger opening with a curtain of the same material; it enlarges the small orifice, to permit its exit when a perfect moth, but takes care to spin over it a temporary canopy of silk, which it can burst through without difficulty.

Fig. 3594 represents these conical cases, both of the natural size and enlarged.

There is a small caterpillar which feeds upon the willow and inhabits a case or dwelling which it carries about with it as its home. It is well known that the catkins of the willow become, as they ripen, covered with fine down; one of these catkins, wonderful to relate, is selected by the caterpillar, which burrows into it, rendering it tubular, and lining the interior with silk; this done, she detaches it from the slender twig on which it was growing, and proceeds to feed, protruding the head for that purpose, but withdrawing it on the appearance of danger. If blown into the water, which often happens, as the willow is generally near streams and ponds, the catkin tenement floats lightly, with every chance of being driven to the bank, the caterpillar thus having an opportunity of regaining the same or an adjacent tree. Fig. 3595 represents a branch of the willow with downy catkins: *b*, catkins appropriated by caterpillars; *c*, the caterpillar.

Many caterpillars are leaf-miners, winding a tortuous course between the upper and under cuticle, and feeding on the parenchyma, or intervening structure; and from the transparency of the former, leaving their track clearly visible. The caterpillars of some of the small weevils (Curculionidæ) are leaf-miners, as are those also of a few dipterous flies, but most are the larvæ of minute moths (Œcophora), which beneath a lens show the most dazzling brilliancy and iridescence.

The insect deposits an egg on the surface of a leaf, the caterpillar when excluded immediately bores its way in, and begins to tunnel, and as it increases in size the mine is of course enlarged, yet without the cuticle being injured. Sometimes it is only on the upper surface of the leaf that the track of the caterpillar is clearly perceptible, showing that, delicate as a leaf may be, the insect has only devoured the upper half of the intervening parenchyma. Fig. 3596 shows the leaves of the monthly rose-tree mined by the caterpillar of the golden silver-spot moth (Argyromiges Rayella). In the centre of the tortuous course made by this caterpillar a dark line may be observed; it is formed by the liquid rejectamenta of the insect. In this instance the track is to be seen only on the upper surface. Fig. 3597 represents the leaves of the common bramble (Rubus fruticosus) in which the winding track of a mining caterpillar is visible on both sides. Fig. 3598 shows a leaf of the primrose (Primula veris) mined by the caterpillar of a small brilliant moth (Œcophora).

In some instances the mining caterpillar feeds on different plants, and even on exotics, as well as indigenous. The larvæ of a small dipterous fly (Tephritis Serratulæ) has been known, for example, to mine the leaves of the Cineraria cruenta and the American groundsel (Senecio elegans), both exotics; it is common on the sow-thistle (Sonchus oleraceus). Fig. 3599 represents—*a*, the Tephritis Serratulæ; *b*, the mined leaf of a sow-thistle; *c*, the mined leaf of Senecio elegans; *d*, the mined leaf of Cineraria cruenta.

Let us now advert to insects the larvæ of which are aquatic, some being organized for respiring the surrounding fluid, others having an apparatus for breathing atmospheric air.

We may first notice the Ephemera, or May-fly, of which there are several species; the larvæ are aquatic, living two or three years in the water, generally of streams and rivers, where they conceal themselves in holes which they excavate under the bank or beneath stones or pieces of timber.

The spiracles of these larvæ are at the base of a series of fin-like fringed appendages or gills extending down each side of the body, and into these the tubes convey the water, which undergoes decomposition, or at least has the air separated from it and transferred to the tracheæ. These fins are in continual and rapid agitation, but by what process the separation of the air becomes effected is not very clear. Besides these lateral appendages the larvæ have three pairs of limbs which enable them to crawl about. The pupa differs but little from the larva, except in having a case on the thorax enclosing the future wings, and when about to undergo its last change it seeks some dry place, a stone rising out of the water, or a plant, and the skin bursting at the head and thorax the ephemera emerges; the wings soon expand and the insect takes to flight: strange to say, however, it has to undergo another process, in which respect the ephemera is without a parallel as far as known among insects. After being released from the skin of the pupa, and flying to a considerable distance, the ephemera settles, and withdraws its body, limbs, and even wings from a thin pellicle which has enclosed them, as a glove encloses the hand. So slight is the opening through which the insect withdraws itself, and so exactly does the exuvium resemble the insect (for it remains *statu quo* attached to the spot where the ephemera disrobed itself), that it may be mistaken for the living being.

The ephemeræ attain to maturity and pair; the females lay their eggs, and in a few hours the winged multitude has perished. Some species are disclosed after sunset, lay their eggs and die before sunrise; some live but about three or four hours.

Fig. 3600 shows the perforations of the larvæ of the ephemera: A, the larva; B, perforations in a river bank; C, one of the perforations laid open to show the parallel direction.

Fig. 3601 represents a submerged portion of a willow-tree, which had been previously bored by the caterpillar of Cossus ligniperda; of the holes, filled with moist clay, the larvæ of the ephemera had availed themselves, and there taken up their quarters.

Fig. 3602 is a dissection of the larva of the May-fly: *a a a*, spiracles; *b b b*, lateral tracheæ. The central nervous chain with its ganglia is well represented. The fin-like appendages of one side are removed.

Ephemeræ sometimes appear in astonishing multitudes, filling the air for miles. We have ourselves seen them "thick as autumnal leaves in Valambrosa," on the banks of the Wye in Derbyshire; they covered the stones jutting out of the stream, the gates, and the stumps of trees, and multitudes drifted into the water and became the prey of the trout and the grayling.

A scene of this kind was witnessed by Réaumur on the banks of the Marne:—"The myriads of ephemeræ which filled the air over the current of the river, and over the bank on which I stood, are neither to be expressed nor conceived. When the snow falls with the largest flakes and with the least interval between them, the air is not so filled as it was around me with ephemeræ: scarcely had I remained in one place a few minutes when the step on which I stood was quite concealed with a layer of them from two to four inches in depth. Near the lowest step a surface of water of five or six feet dimensions every way was entirely and thickly covered by them, and what the current carried off was continually replaced. Many times I was obliged to abandon my station, not being able to bear the shower of ephemeræ which, falling obliquely, struck every part of my face, filling my eyes, mouth, and nostrils."

The fishermen of the Marne and Seine, to whom these insect-showers are welcome, say respecting them when they commence,—"the *manna* begins to fall," or "the *manna* is abundant."

The larvæ of the Phryganeæ, a group allied to the Ephemeræ, and also often called May-flies, live in the water, and make for themselves curious habitations, which, snail-like, they drag about with them as they crawl along the sandy bottom of rivers and streams. The fisherman knows them by the name of Caddis-worms, as he knows those of the ephemera by the name of Bank-bait.

These Caddis-worms, the larvæ of different species of Phryganea, construct their tenements respectively of various materials: some glue bits of stick together, and thus make a rough case; some use portions of reed; some fragments of rushes, and form a fluted cylinder; some roll portions of leaves spirally around them, some avail themselves of fine particles of sand; and form a very neat and compact cylinder; others agglutinate together small river-shells, minute pebbles, bits of stick, and other materials, making a rough domicile, lined, however, with soft silk.

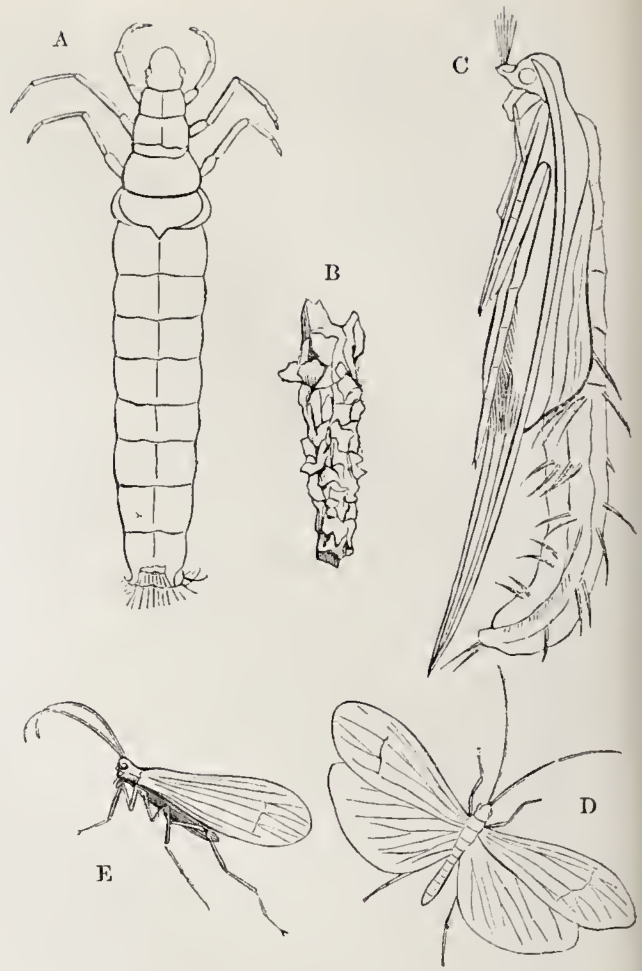
Fig. 3603, the rounded case of a caddis-worm, made of the leaves and bits of stems of aquatic plants, and secured to a reed. Fig. 3604, the case, made of portions of reed joined together.

In clear water these larvæ may be observed, with their head and legs protruded, crawling about in quest of food, and dragging their case after them. We have seen numbers surround a crushed snail, purposely thrown in, and commence devouring it.

Many of the larvæ of the Phryganeæ are very

3595.—Willow-branch with Downy Catkins.

3596.—Leaves mined by Golden Silver-spot Moth.



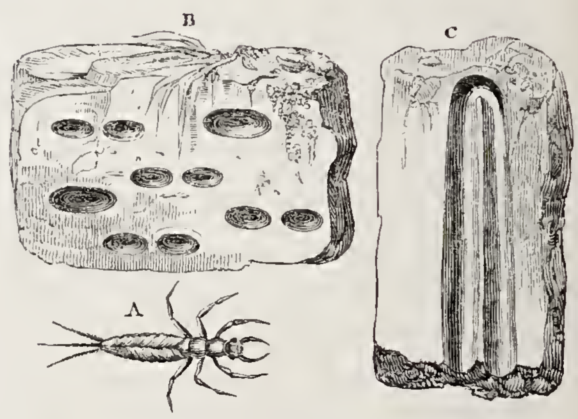
3605.—Transformations of Phryganea.

3598.—Leaf of Primrose, mined.

3597.—Leaves of Bramble, mined.

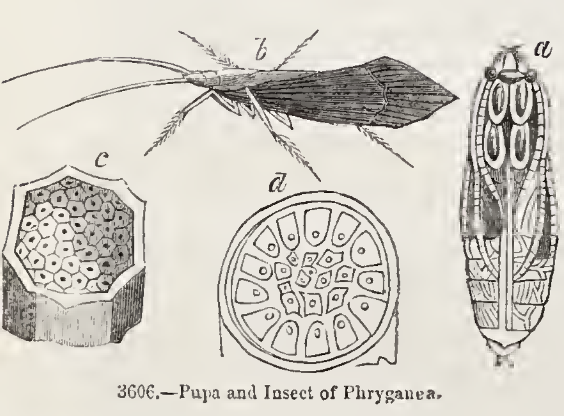
3601.—Nests of Ephemera in holes of Cossus.

3604.—Nest of Caddis-worm.

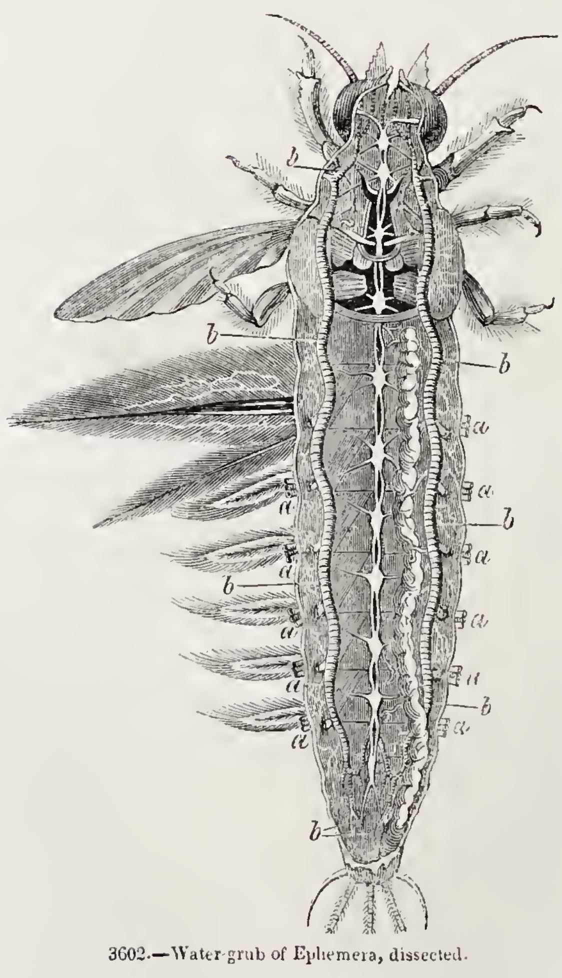


3600.—Larva of Ephemera and Perforations.

3603.—Nest of Caddis-worm.

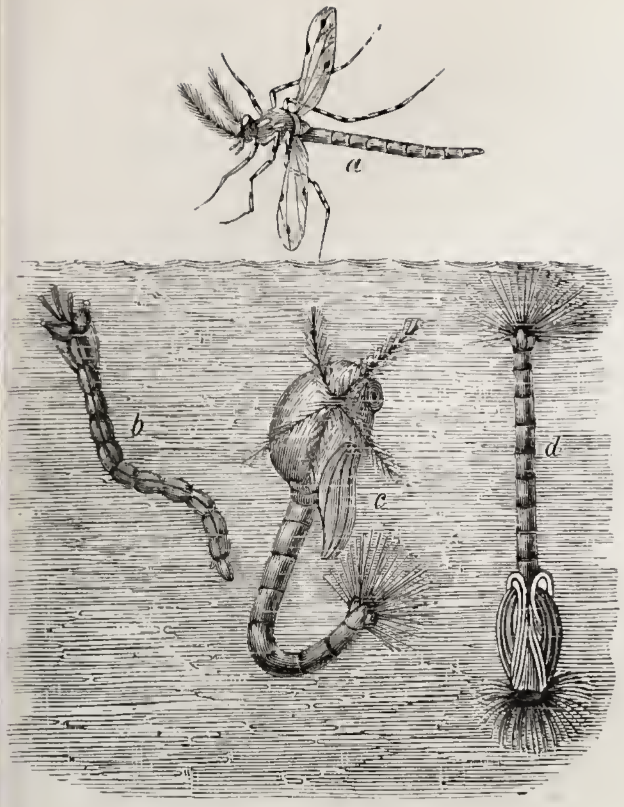


3606.—Pupa and Insect of Phryganea.



3602.—Water-grub of Ephemera, dissected.

3599.—Leaf-mining Maggots.

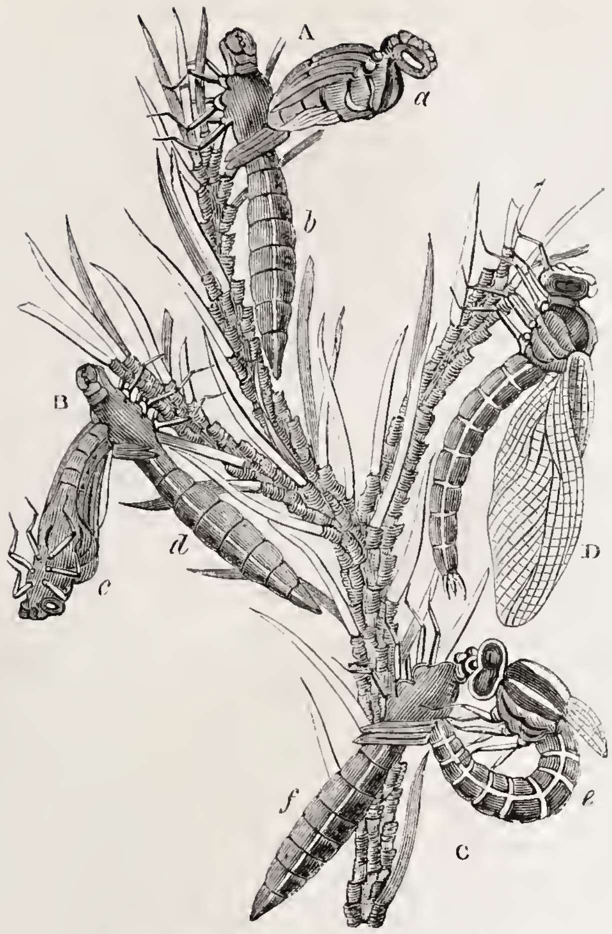


3611.– Changes of Chironomus plumosus.

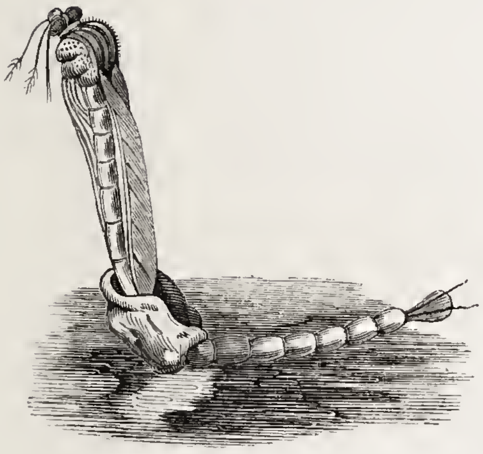
3613.—Larvæ of Gnat.

3619.– Larvæ of Rat-tailed Maggots.

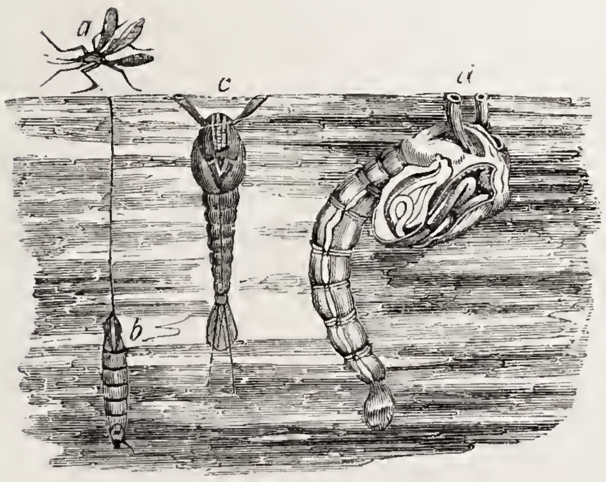
3610.—Dragon-Fly.



3609.– Extrication of Dragon-Fly from Pupa.



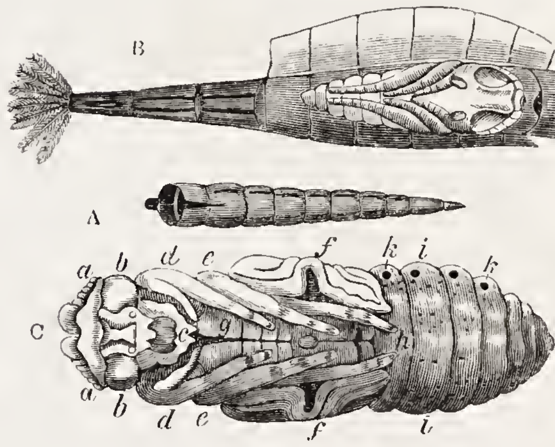
3615.—Gnat escaping from Pupa.



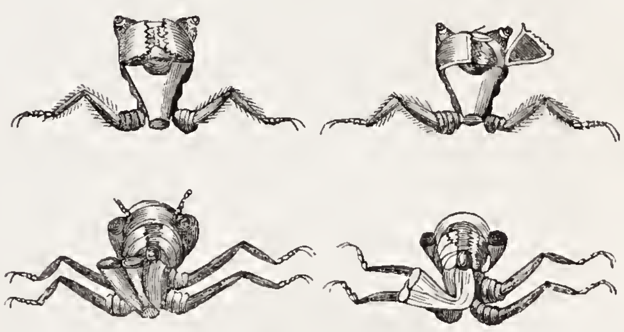
3614.—Tipula and Pupa.

3612.—Larva of common Gnat.

3618.—Larva of Corethra plumicornis

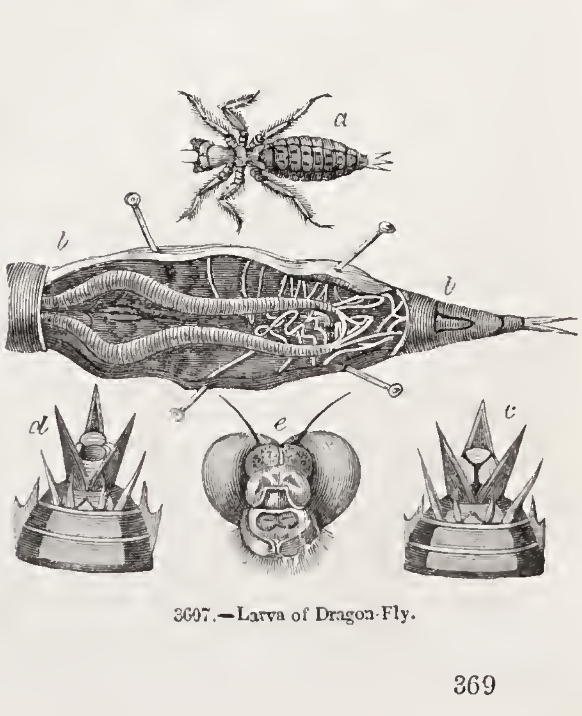


3617.—Pupa of Chameleon-Fly.



3608.—Musk of Larva of Dragon-Fly.

3616.—Larva of Chameleon Fly.



3607.—Larva of Dragon-Fly.

careful in the adjustment of the specific gravity of their case to their powers, adding a little sand or gravel to it if too light, a straw or bit of rush if too heavy.

When the caddis-worm is about to assume its pupa state, it withdraws itself completely within its case or tenement, and then closes the orifice with a grating of silk, which hardens and remains insoluble. This grating admits the water necessary for respiration, but effectually keeps out intruders, for the threads of which it is made are strong, and cross each other so as to form a perforated plate. The time of change having arrived, the pupa, which is furnished with hard and horny mandibles, which are temporary and about to be lost, cuts through the silken grating and creeps forth; it then swims by the action of its limbs to the surface, or adheres to any object; the skin splits, and the perfect insect emerges.

Fig. 3605 shows—A, the larva of a species of Phryganea, magnified; B, the case inhabited by the larva; C, the pupa, magnified; D, the perfect insect with the wings expanded; E, the same with the wings in the ordinary position when at rest.

Fig. 3606 shows—*a*, the pupa of Phryganea; *c* and *d*, the appearance presented by the grating of silk with which the orifice of the case is closed up; *b*, the perfect insect.

In some parts of the Continent showers of Phryganeæ resemble those of the Ephemeræ, filling the air for a considerable distance. They fly chiefly in the evening. The wings are light and semi-transparent, like gauze. M. Latreille retains these insects in the order Neuroptera, but they constitute the type of the order Trichoptera in the system of Messrs. Kirby and Spence.

The larva of the dragon-fly is aquatic, and the perfect insect on wide-spread wings may often be seen sweeping round ponds and lakes, or the sluggish parts of rivers, for the purpose of committing its eggs to the fluid element, in which the young brood are destined to live.

The larva of the dragon-fly has six legs, and creeps about the stems of aquatic plants in search of prey. Its mode of progression, however, through the water is very extraordinary. Appended to the posterior extremity of the body are five leaf-like processes, fringed with hairs, and capable of being closed together or expanded at pleasure; these surround the orifice of a cavity furnished with strong muscular walls. Into this cavity the larva takes in a certain quantity of water, which it instantaneously rejects with considerable force; repeating this action it thus propels itself along by a quick series of jerks, each ejective stroke giving the impulse.

The larva of the dragon-fly is as voracious in the water as the perfect insect is in the air; it devours other aquatic larvæ, as those of the ephemeræ, and even tadpoles; and a prehensile apparatus of the most curious construction is given to it in order to enable it more securely to seize its prey. The anterior part of the head is covered by a mask in three parts, capable of being opened, and of closing and securing the prey, which is conveyed to the true mouth. These three pieces may be likened to the parts of a helmet covering the face, but the visor, instead of being raised up, opens in the middle, transversely, and the inner edges, where they meet, are armed with sharp teeth. Each of these plates then turns back, as it were, exposing the mouth. The mask is in fact a strange modification of the under lip, so inconspicuous in most insects, but in this larva singularly developed and fashioned.

Fig. 3607 represents—*a*, the larva of the dragon-fly; *b*, the abdomen, laid open to show the respiratory vessels, or tracheæ; *c*, the pumping apparatus, shut; *d*, the same, open; *e*, the head of the insect.

Fig. 3608 represents the mask of the larva of the dragon-fly, in four different states of opening and shutting.

The pupa differs little from the larva, except in displaying the encased rudiments of the wings.

We have often witnessed the exclusion of the perfect insect from the pupa, and a number of dragon-flies and pupa-cases are now before us, taken on the banks of the Kennet, near Reading, where thousands were then to be seen; some yet in the pupa state, others emerging from the pupa-case, and others, with wings still wet and crumpled, waiting the moment of their full invigoration. When the time for the disclosure of the perfect insect approaches, it leaves the water, and, crawling up the bank, ascends a stalk of grass, or any other plant, and there clings firmly with sharp claws. In a short time, owing to internal pressure, the back of the thorax splits longitudinally, and as regularly as if a sharp instrument had made the incision, and the head and thorax of the perfect insect make their appearance; in a little time it begins to rise more completely, and to draw its legs out of those of the pupa, as out of cast-off boots; afterwards the whole body is extricated. There, by the side of its slough, as if exhausted and feeble, the dragon-fly rests: its wings are small, crumpled, and powerless; and it is inanimate and without the means of escape. In a short time, however, the body elongates, the wings gradually expand; it begins to vibrate them as if to try their strength; suddenly it rises and wheels in rapid flight through the sunny air. On looking at the pupa-case, we find the fissure has so nicely closed that it is only by looking attentively it can be discovered: the slough remains still clinging to the stalk, and without examining it, one could scarcely tell whether it was a living pupa or only the empty case.

Fig. 3609 exhibits the changes described: A, the dragon-fly beginning to escape from the pupa; *a*, the fly; *b*, the pupa-case: B, the process further advanced; *c*, the fly; *d*, the pupa-case: C, the fly nearly free, and forming an arch while it extricates the body; *e*, the fly; *f*, the pupa-case: D, the dragon-fly with the wings in a great measure developed. Fig. 3610 represents the perfect insect.

The Gnat tribe (Culex) and many of the Tipulæ are aquatic during their incomplete stages.

The larva of one species of the latter, the Chironomus plumosus, is abundant in ponds, and even rain-water tubs. We have seen the water teem with these creatures, which are like little red wriggling jointed worms, perpetually swimming about. The caudal extremity is furnished with several small appendages, regarded as an organ of aquatic respiration. In the pupa state these appendages are replaced by a tuft of fine bristles, and a coronet is produced on the head like a five-starred ray of plumes, and a double envelope projects from each side of the thorax, enclosing the limbs.

The pupæ undergo their change on the surface of the water with the thorax above it, and in allusion to this fact Messrs. Kirby and Spence ask, "How can a pupa of greater specific gravity than the water remain suspended without motion at its surface, and how can its thorax, which is its heaviest part, be kept uppermost?" The solution given is, that the middle of the thorax is oleaginous, and repels the water, and that as soon as the pupa by its exertions has forced this part above the surface, the water retreats from it, and the attraction of the air acting on the dry part is sufficient to counterbalance the body's gravity, as a needle being very dry will float on water from the same cause.

May it not, however, we would ask, be that previously to the last change the body, by the expansion of the internal parts, becomes really so light as to remain floating? This is a mere suggestion.

Fig. 3611 shows the changes of the Chironomus plumosus: *a*, the gnat, with its plumed antennæ; *b*, the larva of the same, called the blood-worm; *d* and *c*, pupæ of the same, magnified.

We have previously alluded to the egg-raft of the gnat (Culex pipiens). The larva is aquatic, but breathes air; it is of strange figure, and its movements with the head downwards are singularly quick and active. As atmospheric air is necessary for its existence, there is an express organization for obtaining a due supply. On looking at these larvæ in a quiescent state, we find them invariably at the surface of the water, with the head hanging down and the tail above. Now on examining one through a lens we find it to consist of a long slender body, and a large thorax, with a strange-looking head, scarcely less in magnitude. The tail appears bifid, but in reality it gives off, before its termination, a breathing-tube. At the end of this tube is a circlet of moveable hair-like appendages, so arranged as to sustain the creature at the top of the water, and thus serve as a float. The respiratory tube, which is just raised above the surface of the water, is connected with the internal air-vessels, and is thus adapted for its assigned use.

The segments of the body and the thorax are furnished with radiatory pencils of fine hairs, and on the head are two cilia, by the movements of which food is brought to the mouth. It is from the vibratile action of the body that the animal swims about, and the fine hairs with which it is furnished seem to contribute to render it buoyant, for when its actions cease it begins to ascend to the surface without any visible effort.

Several times before assuming the pupa state this larva moults its skin, but when this state is attained the creature would scarcely be recognised as the same. The thorax and head appear to be no longer divided, but form one continuous portion, within which the outlines of the perfect insect may be detected. The elongated tail-like body is still used as an organ of locomotion, and the pupa floats at the surface, but not in its former attitude. It now swims with the back of the thorax uppermost, and a remarkable change has taken place in its respiratory apparatus; the caudal tube has become obliterated, and in its place two short tubes rise from the back of the thorax, so as to have their orifices just above the surface. These alterations prepare the way for the escape of the insect from its pristine element into the air.

Floating, as we have said, with the back of the thorax uppermost, the pupa, as the important crisis draws near, becomes still more buoyant, till its back rises above the water. The membranous integument now begins to dry, it then splits longitudinally, and, gradually expanding, forms a boat, in which rests, unwetted and secure, the perfect insect. It floats on a coracle of its own pupa-case, which it leaves behind as it rises on fluttering wings to join the mazy dance of its kindred myriads.

Fig. 3612 represents the larva of the common gnat (Culex pipiens) floating in water: *a a*, the head and body; *b*, the caudal respiratory tube; *c*, the larva, of the natural size. Fig. 3613 shows several of the larvæ and pupæ in a glass vessel of water.

Fig. 3614 shows at *c*, the pupa of the gnat, front view; *d*, a lateral view of the same, with its dorsal tubes; *a*, is a species of Tipula, and *b* its pupa, the respiratory tube of which is many times larger than the body, and as fine as a hair; its extremity always remains above the surface of the water, for the purpose of carrying on respiration. Fig. 3615 shows the gnat escaping from its floating pupa-case.

There is a two-winged fly, called by Goedart the Chameleon-fly (Stratiomys Chamæleon), the larva of which is aquatic, and is at the same time beautifully provided with the means of atmospheric respiration. The terminal ring of the body is considerably elongated, and the respiratory orifice is fringed around with about thirty feathered filaments, forming a beautiful star. These constitute a float, and repel the water, in which the creature rests suspended with the head downwards: when it wishes to descend, it brings the filaments together, enclosing within them a bubble of air for respiration under the water, and the bubble appears like a brilliant pellet of burnished silver.

When the period of transformation into the pupa draws near, this larva forsakes the water, and creeps up the bank, or on the leaf of some aquatic plant, with only a portion of its tail submerged. It now becomes motionless, and the embryo fly enclosed begins to contract within its case, while its wings and limbs gradually develop. Into the vacant space around it, and which it previously occupied, the air enters for the supply of the insect, which soon opens a sort of lid at the top of the dry conical pupa-case, and emerges. Fig. 3616 represents the aquatic larva of the Chameleon-fly with its caudal apparatus expanded.

Fig. 3617 represents—A, the pupa of the chameleon-fly with the lid of the pupa-case raised; B, the same, magnified to show the contracted embryo of the fly in its case, which it does not even nearly fill: C, the embryo fly, magnified; *a a*, antennæ; *b b*, the eyes; *c*, the sucker; *d d*, first pair of legs; *e e*, second pair; *f f*, wings folded up; *g*, *h*, *i*, rings of body; *k k*, stigmata, or respiratory orifices.

The larva of a Tipulidan gnat (Corethra plumicornis) is remarkable for its crystalline transparency, and from this and its minute size it is not very easy to discover. It is less than a quarter of an inch in length, and is furnished with horny jointed mandibles, capable of being united into one pointed borer. The tail is furnished with a pencil of plumed bristles, which may perhaps serve for aquatic respiration, and also as organs of locomotion. As this transparent larva approaches the pupa stage, two kidney-shaped brown bodies become visible within the first ring succeeding the head, and two smaller in the fourth ring from the last. The first, perhaps, enclose two singular horns, which appear on the pupa, and the latter two tail-paddles. The transition from the larva into the pupa state, according to Réaumur, is by a change of skin, and the antennæ of the perfect insect are enclosed in the horn-like appendages of the latter. The pupa is very lively, jerking about, and generally keeps close to the surface of the water, above which its horns project.

Fig. 3618 shows—*a a*, the larva of Corethra plumicornis, magnified; *b*, the mandibles and palpi; *c*, the respiratory appendages; *d*, the pupa, magnified; *e*, the pupa, natural size; *f*, the larva, natural size; *g*, the female fly; *h*, the male.

All are acquainted with what are termed rat-tailed maggots, common in filthy drains, in oozy mud, and similar places. It is the larva of a species of two-winged fly, very like a bee in appearance, the Helophilus pendulus, and its singular tail is an apparatus for breathing admirably adapted to its necessities. This instrument consists of an outer tube, within which a much finer tube, capable of being extended to a very great length, is retracted when not in use; both are composed of fibrous rings, and are of amazing extensibility. The contrivance for extending the inner tube appears to be very simple, and yet extremely efficient: it receives at its base two flexible pipes, coiled up when at rest, which are continued from the internal tracheæ, or air vessels,

and by urging the air from the tracheæ into the coiled pipes, it extends them and forces out the inner tube to the requisite degree, so that it may emerge above the ooze in which the maggot lives. Were it not for such a contrivance the maggot must be suffocated. Fig. 3619 shows several of these larvæ in a glass of water, *a*; *b*, is a magnified view of the tail, with the breathing-tube partially contracted; *c*, a still more enlarged view of the tail.

These larvæ must not be confounded with certain fresh-water worms, or Annelides (Naïs), which live in holes which they burrow in the mud at the bottom of the water, and from which they protrude the anterior elongated part of their body, which they incessantly move about. The long proboscis of the Naïs proboscidea is very conspicuous, but is by no means analogous to the tube of the larva in question, and the two animals must not be confounded with each other. The Naïs is reddish, the maggot of a dirty whitish hue.

Fig. 3620 represents—*a a*, a group of Naïs proboscidea, half concealed in the mud; *b b*, several of the entire worms.

The maggot of a dipterous fly (Bibio hortulanus) which in its perfect state sips the nectar of flowers, or the gum with which the opening bud is often moistened, is very common in cesspools and oozy ditches of filth. It is of a flattened oval form, with lateral tufts of bristles on its rings, and these tufts are probably branchial organs; its skin is extremely hard and tough, insomuch that it resists considerable pressure. The egg from which it is hatched is covered with a shell as hard as if made of plaster of Paris.

Fig. 3621 represents—*a*, the egg, magnified; *b*, the same when hatched; *c* and *d*, the maggot and pupa, magnified; *e* and *f*, the maggot and pupa, of the natural size; *g*, the fly.

We might here close our general survey of larvæ and of the pupæ or nymphs which they become previously to the development of the perfect insect. We may, however, advert to a few pictorial groups which show the larvæ and pupæ of certain leading forms, contrasted with the normal conditions of an insect which has passed through all its transitions.

Fig. 3622 shows—*a*, the ametabolous pupa of a Cicada, which moves about and feeds, and awaits the growth of wings to become perfect; *b* is the caterpillar of the Tussock-moth (Laria fascelina); *c*, the larva of the Poplar-beetle (Chrysomela Populi); *d*, the larva of Sirex; *e*, the aquatic larva of the gnat, active in its pupa state.

Fig. 3623 represents—*a*, the pupa of a water-beetle (Hydrophilus), and *b*, the pupa of the Privet Hawk-moth (Sphinx Ligustri).

Fig. 3624 represents a group of perfect insects, in which the development of the wings is well displayed: *a*, a neuropterous insect, Nemoptera, Latreille (Nemopteryx, Leach); *b*, the Ant-lion (Myrmeleon formicarium, Linn.), one of the Neuroptera; *c*, the Hesperia Comma, a butterfly, one of the Lepidoptera; *d*, the Water-scorpion (Nepa cinerea), an aquatic hemipterous insect, with ametabolous larvæ.

We may here add that a perfect insect is often called "*Imago*," a term used by Linnæus to designate a perfect insect, because having thrown off its pupa-mask the animal may be taken as an *image* of its species.

The great object to be accomplished by the perfect insect is the continuance of its race; to this end are all its labours, all its energies, all its instinctive contrivances devoted; and it has then only to die. Some insects are beings of a day—others endure for months, some few for a longer period. In making his collections, then, the entomologist only abbreviates an existence which a few days or weeks must in general terminate.

Let us now proceed to a few considerations relative to perfect insects; premising that our space will only allow us to select from among multitudes, for the subjects of our short comments, such as are peculiarly interesting either from their structure, habits, or beauty. The first insect, then, that claims our notice is the Hive bee. Wax and honey we know to be the products of several species of bee, but that which has been kept in Europe, in artificial hives, for the sake of its products, and has been celebrated from the earliest antiquity, is the Apis mellifica, and true as formerly is the line attributed to Virgil:—

"Sic vos non vobis mellificatis apes."

Bees are social insects; they combine to work for the general commonweal; they obey certain laws, and proceed upon certain principles in their economy and operations, which give them great interest. The mysteries of the bee-hive have not yet been fully fathomed.

It is useless to enter into a particular description of a bee-hive with its waxen cells. We know that it contains a series of vertical plates, having closely arranged hexagonal cells (with pyramidal bases composed of three rhomboid pieces), horizontally directed on each side. Much has been written, and learnedly too, respecting the saving of room and wax by the hexagonal figure of these cells, and many a good page of abstruse mathematical problems has been elaborated, to prove that the angles of the rhomboid pieces, forming the base of these cells, are precisely such as bees of a saving turn and mathematical genius might be expected to make.

The cells, as we have said, are constructed of wax, but not exclusively; they are strengthened and smeared with a gummy or resinous varnish called propolis. The use of these cells is threefold; they serve as receptacles for the eggs and larvæ, as magazines for honey, and as storehouses for bee-bread.

A hive of bees consists of from twelve to sixteen or eighteen thousand individuals, divided, first, into workers, or females incapable of reproduction; secondly, into stingless males, or drones; and thirdly, a female called the queen-bee—the parent of the future progeny of the hive. Besides these there are the eggs and larvæ, forming the rising brood.

The males, or drones, amount to several hundreds, but the bulk of the population consists of workers. Now at the outset here arises a question—to what are we to attribute the difference between the workers and the queen? If we examine the wax-combs of a bee hive, we shall find the cells for containing the larvæ of three sorts. Those built for the males, or drones, are larger than those intended for the workers, or sterile females; and those for the future queens of different broods, usually three or four in number, and termed royal cells, are still larger and shaped somewhat like a Florence flask. The honey-cells differ little from those for the workers, but are generally deeper, the rims being more raised. Now the queen-bee deposits first, it would appear, eggs containing future queens and workers, and afterwards those of future males; and further it seems that the difference in the size of the cells, added also to the nature and quality of the food with which the female larvæ are nourished, conduce in the one instance to the production of a large and fertile queen-bee; and in the other, to the rearing of the ordinary worker, with its curious instincts. But it may be asked—how is this proved? If the bees, as has been satisfactorily demonstrated, are deprived of their queen, and have combs containing only young of the working brood, they will select one of these larvæ, not more than three days old from the egg, and proceed to alter and enlarge its domicile by breaking down the adjacent cells, and emptying their contents, whether honey or larvæ. They build up, in short, a royal cell around the object of their choice, giving the cradle a vertical instead of horizontal direction, and nourishing the larva with a peculiar diet. In three days (the larvæ being two days old when selected) it begins to surround itself with a cocoon of silk, and afterwards assumes the pupa state. The workers now shut up the cell with wax, as they do those of the pupæ of drones and workers. In a few days the pupa is hatched, and the queen comes forth among her devoted subjects. By such means is the larva of a worker-bee transformed into a queen.

We may here observe, that sixteen days is the period assigned for the preparatory stages of a queen-bee, viz.:—Egg, three days; a feeding larva, five days; not feeding, but spinning its cocoon, one day; still and quiet, two days and sixteen hours; pupa, four days and eight hours. Total, sixteen days.

The workers require twenty days, the males twenty-four.

The queen-bee is the most important personage in the hive, and jealous in the extreme of her prerogative; she bears no rival, but as several royal pupæ are in each hive, the first hatched queen visits those cells, and, if not prevented, kills the larvæ; but should two rival queens appear at the same time, they engage in mortal combat, and one falls a sacrifice.

We generally find several (four) swarms issuing every year from the same hive, each headed by its queen. The first swarm is conducted by the old reigning queen, who previously to her departure has at separate intervals laid female eggs in the royal cells; of these, the first-born is usually the fortunate candidate for the vacant throne, and in turn leads off another swarm, and so on in succession. "The longest interval," say Kirby and Spence, "between the swarms is from seven to nine days, which is usually the space that intervenes between the first and second; the third flies sooner, and the last sometimes departs the day after the third. Fifteen or eighteen days are generally sufficient for throwing the four swarms. The old queen, when she takes flight with the first swarm, leaves plenty of brood in the cells, which soon renew the population."

The young queens that conduct the succeeding swarms usually pair the day after their settlement in their new abode, and are then the objects of homage and respect.

There is, says Kirby, "something singular in the mode in which the workers treat the young queens that are to lead the successive swarms. After the cells (of the pupæ) are covered in, one of their first employments is to remove here and there a portion of wax from their surface, so as to render it unequal (see Fig. 3625, a royal cell; *a*, the side view of the same); and immediately before the last metamorphosis takes place, the walls are so thin that all the motions of the enclosed pupa are perceptible through them: on the seventh day the part covering the head and trunk of the young female is almost entirely unwaxed." It might be concluded, perhaps, that all things being prepared for the coming forth of the enclosed queen, that she would quit her cell at the usual period; and doubtless, were she to pursue her own inclinations, such would be the case. But here the bees show how admirably their instinct guides their operations for the welfare of the community. Did the new queen leave her cell, she would immediately attack and destroy those in the other royal cells; a proceeding which is permitted only when a successor merely is wanted to a dead or lost queen, and not the leader of a swarm to be succeeded by others. As soon, therefore, as the workers perceive that the young queen has cut through her cocoon, they immediately solder up the cleft with wax, and keep her a prisoner against her will. Upon this, adds Mr. Kirby, "as if to complain of such treatment, she emits a distinct sound, which excites no pity in the breasts of her subjects, who detain her two days longer than nature has assigned for her confinement." In the interim she sometimes thrusts her tongue through the slit she has made in the cocoon, upon which she is supplied with honey; after which the orifice is stopped with wax.

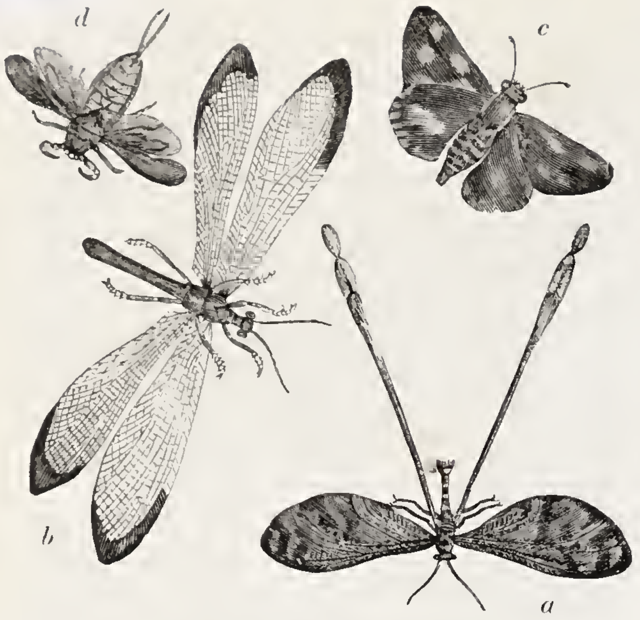
Were a queen, destined to lead a swarm, permitted to leave her cell as soon as the natural term arrived, it would require some time to fit her for flight; during which time a troublesome task would be imposed upon the workers, who must constantly detain her by force from destroying the larvæ and pupæ of the succeeding queens. Hence they find it easier to detain her in her cocoon till she is ready to head the swarm, when she is liberated, and prevented from making the desired slaughter till she issues forth with her subjects. The oldest is of course the first so treated; then the next, and so on, till the queen of the last swarm: the remaining queens, the hive being now sufficiently thinned, fight unimpeded till one gains the throne. It sometimes happens that when the original queen and her swarm are prevented from migrating by bad weather, she destroys the young brood in the royal cells, so that when she leaves, the workers who remain have to educate a worker larva into a queen. Generally, however, some of the royal brood escape her vengeance, a favourable change in the weather inducing her to depart.

"When the larvæ in royal cells," says Mr. Waterhouse, "are about to change into pupæ, the old queen begins to exhibit signs of agitation, running carelessly over the cells, occasionally thrusting her abdomen into some of them as if about to lay, but withdrawing without having done so, or perhaps depositing the eggs on the side of the cell, instead of at the bottom. She is no longer surrounded by her usual circle of attendants, and her agitation being communicated to all she passes, at length a general confusion is created; till at last the greater portion of the bees rush out of the hive, with that queen at their head. It is thus that the first swarm quits the hive, and it is invariably conducted by the old queen.

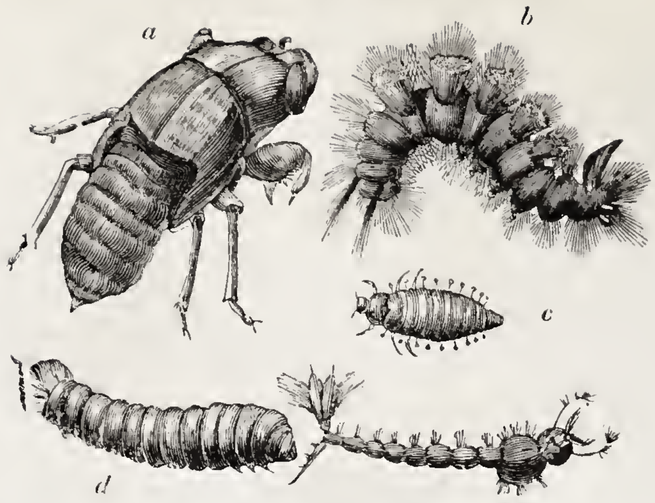
"At any other time the queen would have been unable to fly, the great number of eggs contained in her abdomen rendering her too heavy: this however is sufficiently reduced after the great laying to enable her to fly with ease.

"An unerring instinct obliges the queen to leave the hive at this time, for two sovereigns never can co-exist in the same community; and had she not left it, the young queens (now just about to quit their cells) would inevitably have been killed by her. Let us now observe what is going on in the hive, which has just been deserted by its queen. It would seem as if it were too much reduced by the departure of the swarm; but it must be borne in mind that this event never occurs except in the middle of the day, and during very fine sunny weather, when a large portion of the bees are abroad gathering honey and pollen; and if the hive contain a numerous colony, these, on their return, together with those which have not been disturbed during the general confusion, and a considerable number of young brood continually hatching, form a sufficient stock, and perhaps even enough to send off another swarm.

"In two or three days' time from the leaving of the first swarm, perfect order is restored in the hive; and the nurse bees continue to attend upon the

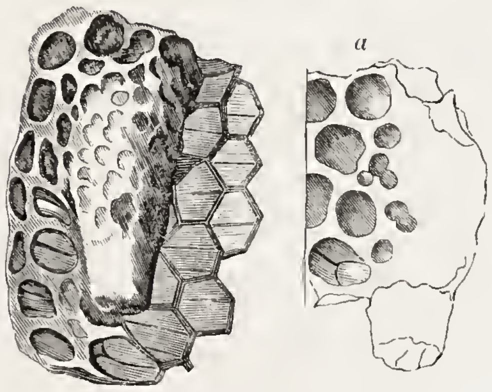


3624.—Insects in the Imago state.



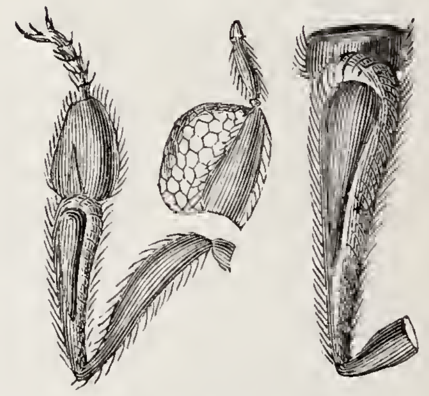
3622.—Caterpillars and Pupæ.

3629.—Swarm of Bees and Apparatus for weighing.

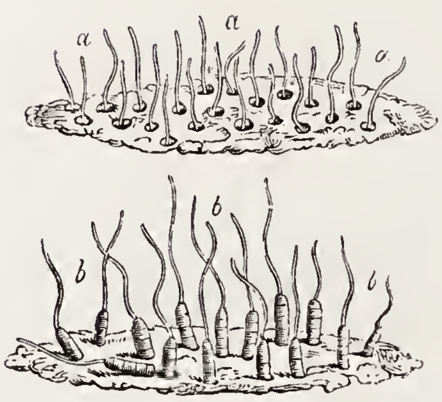


3625.—Queen Bee's Cell.

3626.—Egg, Larva, and Pupa of Bee.

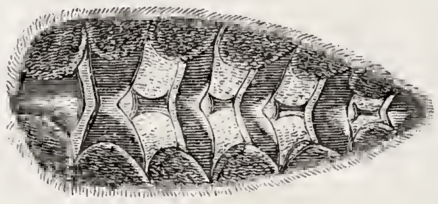


3630.—Hind leg of Bee.

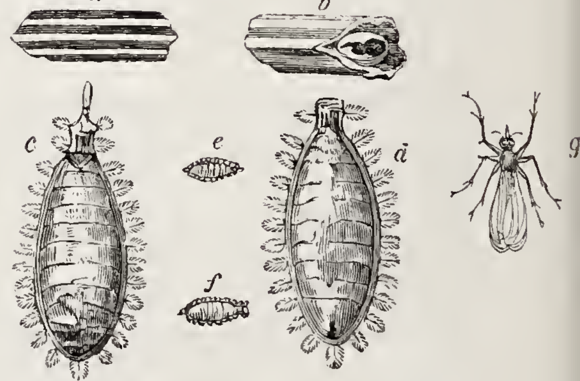


3620.—Naïs proboscidea.

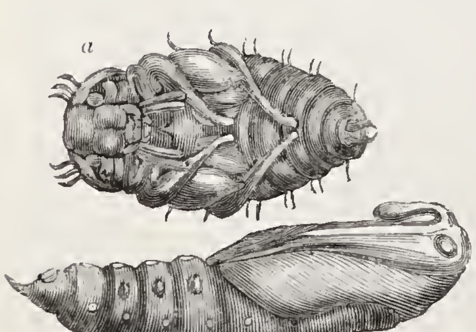
3628.—Swarm of Bees on Laburnum branch.



3632.—Abdomen of Queen-Bee.



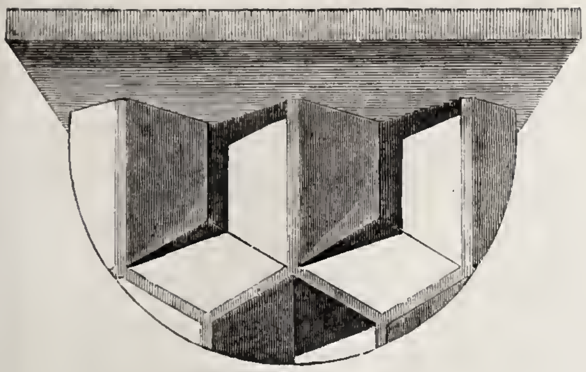
3621.—Stages of Bibio hortulanus.



3623.—Pupa of a Water-Beetle and of Privet Hawk-Moth.

3627.—Hive-Bees.

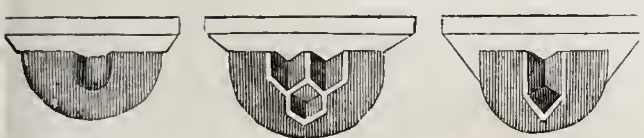
3631.—Under view of Neuter Bee.



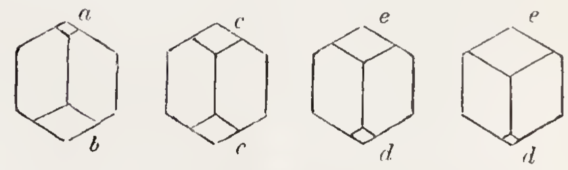
3643.—Cells of Honey-comb.

3636.—Festoon of Wax-workers.

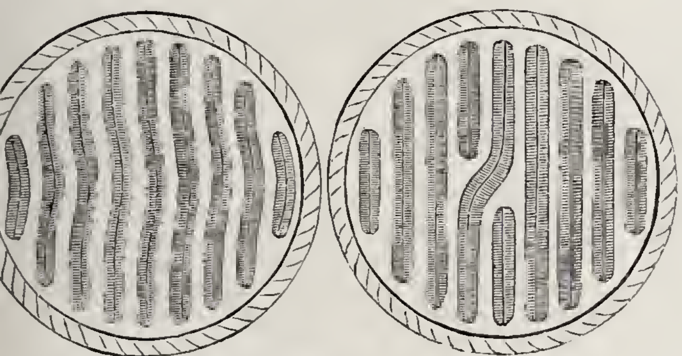
3633.—Part of Honey-comb.



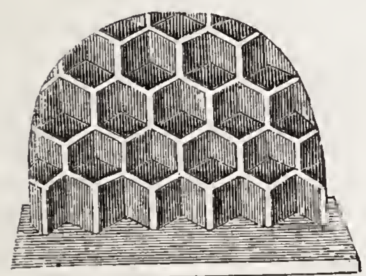
3644.—Progress of Cells of Honey comb.



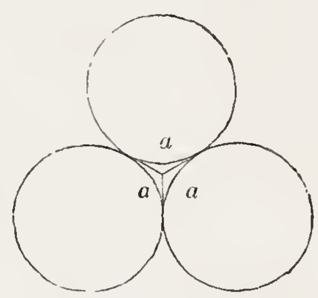
3647.



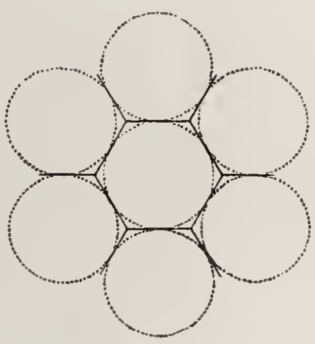
3648.



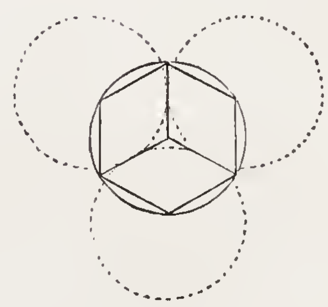
3645.—Cells of Honey-comb.



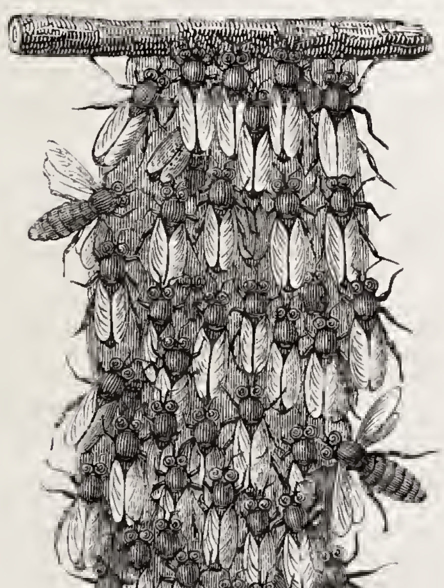
3634.



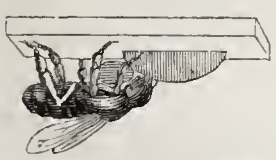
3646.



3635.

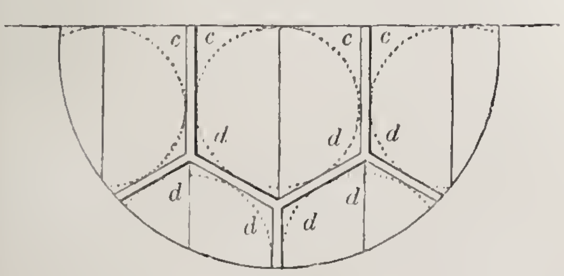


3637.—Curtain of Wax-workers.

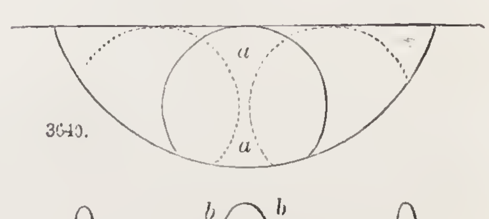


3638.—Bee laying foundation of first cell.

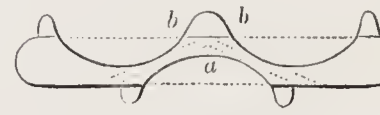
3639.



3642.



3640.



3641.

young, carefully watching the queen's cells, and working at the outsides by removing the wax from the surface. It is said that the wax is removed in order to facilitate the exit of the young queen; but although the removal of it may thus be of service, we are not inclined to think it is done for that purpose."

When a swarm quits a hive, it generally clusters on a tree or bush in the neighbourhood, and if it be not soon secured, it takes flight, and proceeds in search of some convenient abode. In Palestine fissures in the rocks were much frequented by bees, as are the caves of Salsette and Elephanta at the present day.

The custom of making a useless noise by beating iron or sounding instruments in order to induce swarms to settle, is of great antiquity. Virgil says—

> "Tinnitusque cie, et Matris quate cymbala circùm."
>
> *Georg* iv., line 64.

The sole occupation of the female, or queen-bee, is to lay eggs in the various cells prepared by the workers for that purpose; she takes no care of the young herself. Until she is about eleven months old, the eggs laid are all or nearly all those of workers; subsequently those of the males are deposited, generally in the spring. The egg of the bee is about the twelfth of an inch long, of a cylindrical form with rounded ends. When the larva emerges from the egg, it is immediately supplied with food by the nurse-bees. It may be now seen lying in a curved position at the bottom of the cell, where it continues to grow until it has completely filled up the space. When it is full grown, it lies horizontally with its head towards the entrance. The food with which the larva is supplied is a mixture of farina, honey, and water, which is converted into a whitish jelly by elaboration in the stomachs of the nurse-bees. The proportions of farina and honey vary according to the age of the young. Mr. Waterhouse says, "We believe that the food is not given directly to the larva, but disgorged into the cell, so that the insect is surrounded with it. But when the larva is nearly full grown, its food is sweeter (probably containing a greater proportion of honey), and is applied by the nurse-bees to its mouth, somewhat in the manner of a bird feeding its young." Fig. 3626 represents—*a*, the egg of the bee; *b*, the larva; *c*, the pupa of the worker-bee; *d*, the head of the larva, magnified.

Fig. 3627 represents three hive-bees—*a*, the male, or drone; *b*, the neuter, or worker; *c*, the queen-bee. The lines denote the natural length of each. The neuters are of two kinds, small nurse-bees, and larger wax-workers; the nurse-bees are also called sculpturers.

Dividing their labours then, they construct combs, watch and nurse the young, store up honey and bee-bread, make propolis to finish and strengthen the cells, and guard the queen, whose sole duty is the deposition of her eggs in the cells.

With respect to the males, or drones, the purpose of their existence accomplished, they are doomed to death. Produced in April or May, they live till July or August, when the workers commence a general massacre, which continues for two or three days. The motive which actuates the worker-bees in this entire destruction of the males has often been discussed, but is not understood; for it appears that in hives deprived of a queen they remain unmolested, as they do also in the rare cases in which the queen lays only male eggs.*

Fig. 3628 represents a swarm of bees on the branch of a laburnum.

Fig. 3629 represents a swarm of forty thousand bees on the branch of a fig-tree, with Réaumur's apparatus for weighing them and computing their number. We may now notice the products of these industrious tribes.

Honey is the nectar of flowers lapped out of the nectary by the tongue, and conveyed to the crop or honey-bag; here it undergoes but little alteration, and is transferred or disgorged into the cells destined to receive it. Of these some are store-cells, some are filled for daily use. A single cell will contain the contents of many honey-bags, and though the cell is horizontal the honey will not run out, for a thick cream rises and forms a glutinous film, obliquely placed, keeping in the treasure. The store-cells when filled are covered with a waxed lid.

With respect to bee-bread, we may state that while the bee is busy in extracting the sweets of the flowers, it becomes covered with the pollen of the anthers; this pollen it wipes off from its body with the brushes of its legs, collects every particle together, and kneads it into two little masses, which are placed each in a sort of basket on the broad surface of the tibia, or middle joint of the leg, where a series of elastic hairs over-arches a concavity, and acts as a sort of lid or covering. Thus burdened, off the insect flies to the hive; first the honey is safely lodged, then the bee-bread, or kneaded pollen, is disposed of as circumstances may require; sometimes it is eaten by several bees, called by a peculiar sort of hum to their repast, and if more is collected than required for present use, it is deposited in some of the empty cells, to serve as future provision. Fig. 3630 shows the structure of the hind-legs of the bee, magnified.

Wax is a peculiar secretion in little pockets or cells beneath the scales of the abdomen. Of these wax-pockets there are generally four on each side, at the base of each intermediate segment, and concealed by the overlapping of the preceding segment. They are found only in the neuter bees, not in the males or queens. Fig. 3631 shows the under surface of a neuter bee, with the position of the scales of wax. Fig. 3632 shows the abdomen of the queen-bee.

It appears that it is from honey that the wax, by some internal process, is elaborated, as the wax-workers retain the honey when wax is required which they would otherwise disgorge into the cells. The wax oozes out between the abdominal rings, in the form of little laminæ; it is then worked with the mouth, and kneaded with saliva that it may acquire the requisite degree of ductility for the construction of the comb, which is finished with propolis.

Propolis is a glutinous or gummy resinous matter, procured from the buds of various trees, as the Tacamahaca (Populus balsamifera), the birch, &c. This gum the bees draw out with the mouth, prepare it, and having loaded the basket of each hind-leg, return to the hive. It is not only employed in varnishing the cells of the combs, but for stopping up crevices, for coating the sticks which support the combs, and for mixing with wax, and rebuilding weak parts. Often it is spread over the hive dome interiorly. It is of wax then and propolis that the combs of the bee, pierced with hexagonal cells on both sides, are formed. Fig. 3633 represents part of a honey-comb, with bees at work:—

The construction of a comb is one of the difficulties which naturalists have long laboured to explain, and various are the theories which have been entertained as to the mode in which this beautiful piece of workmanship is accomplished. In our own opinion, the most successful attempt is that of Mr. Waterhouse, whose article in the 'Penny Cyclopædia' merits the utmost attention. We shall follow his account, with a few omissions:—

To work in circles or segments of circles appears most compatible with animal mechanism acted upon by instinct, for we observe that the works of almost all insects (perhaps we may say almost all animals) proceed in circles or segments of circles. The cells of almost all the various species of bees are of this construction, and we find that, under peculiar circumstances, those of the hive-bee are so likewise, as in the case of the queen's cell, and in some of those cells close to it, and sometimes in other parts of the comb, in cases where an accident has been repaired.

If some hive-bees could be made to work in a large solid mass of wax, the first cell formed would most probably be cylindrical, with a hollow circular bottom; this would also be the form of the following cells, unless they came in contact with each other; and in this case, supposing the circumferences of three cylinders were to touch, the bees working in each of these cylinders would cut away the wax at *a*, *a*, *a* (Fig. 3634). But supposing the wax-block were excavated on one of its sides, into the greatest number of equal-sized cylinders that it would admit of, it would then follow that each cylinder would be surrounded by six others, this being the only number of equal-sized circles which may be placed round one of the same magnitude: by the same rule of removing the wax from the interstices, these cylinders would become hexagons. Again, supposing this block to be a flat mass of equal thickness in all parts (the ordinary thickness of a comb), this block being cut into cylinders of equal diameter on both sides, and the base of each cylinder being exactly over parts of three opposing ones, when the wax is cut away at the interstices, as at the sides, it follows that the bottoms of the cells will be each composed of three equal rhombus-shaped pieces. (Fig. 3635.) Hence we have cells exactly like those of the hive-bee, but not constructed in the ordinary way, though upon such principles as analogy points out (a circular form being the basis of the work*), and in such a way as we have observed they do occasionally proceed.

Let us now examine the construction of the comb in its usual way of proceeding:—

The first operation is the formation of wax, which is secreted by the insect at the time of building the combs. For this purpose the wax-workers suspend themselves in festoons from the top of the hive. Those which first reach the top fix themselves by the claws of the fore-legs to the roof, and are followed by others which attach themselves to them, until an inverted cone or festoon of bees is formed, each end of which is attached to the roof of the hive. Before the commencement of the new comb, the interior of a hive presents a series of festoons of this description, intersecting each other in all directions, the bees remaining in perfect repose. (See Fig. 3636, a festoon of wax-workers. Fig. 3637 the outline formed by the festoon filled up by a crowd of workers.)

At this time the wax is secreted, and makes its appearance in little scales which exude between the segments on the under side of the abdomen, eight scales being visible in each bee. The wax being secreted, one of the bees commences the comb; having detached itself from the festoon, it makes its way to the roof of the hive, and after clearing a space by driving away the other bees, it detaches one of the scales from the abdomen by means of its hinder legs: this is then conveyed by the fore-legs to the mouth, where it is masticated, and impregnated with a frothy liquid by the tongue, in which process it obtains a whiteness and opacity which it did not before possess. The particles of wax are then applied to the roof of the hive. Another scale undergoes the same process, and is attached to the first. The bee thus continues labouring until all its scales are disposed of; it then quits its situation, and is followed by another bee, which proceeds with its scales in the work already begun, depositing the wax in a straight line with the former deposition. The same operation is performed by many other bees, until a considerable block is deposited. This block is generally about five or six lines long, the height two lines, and the thickness half a line; and it is upon this that the formation of the cells commences. (See 3638, a bee laying the foundation of its first cell.)

We have seen that the foundation of the block is the work of one bee, so likewise is the commencement of the cells;—the former is the work of what is called the wax-workers, which, we are informed by Huber, do not possess the power of sculpturing the cells: the cells are made by the sculpturer-bees, who are smaller than the wax-workers. No sooner is the block large enough to admit a sculpturer-bee between the wax-workers, than the excavation commences. There seems to be an instinctive desire to perform the work of excavation wherever there is room, even though there may not be sufficient to form a perfect cell; for we never observe a solid piece of wax in any part of a comb. On the contrary, if by any accident there has been space unoccupied by cells, we find that the wax has been excavated at that part as much as was practicable.

The bee, impelled by instinct to deposit wax and to excavate, and also guided by an acute sense of feeling in the antennæ (probably through the elasticity of the wax), as to the degree to which the excavation should proceed, forms the comb; and in so doing it seems to act not from choice, but from a necessity imposed upon it by two antagonist principles, one causing it to deposit and excavate wax, and the other acting through the antennæ, and limiting the degree of excavation. (See Fig. 3639, showing the front side and back views in which the excavations for the cells are made.)

It is to this desire for performing the work of excavation that we attribute the small excavations about the royal cells, which are said to be for the purpose of facilitating the exit of the young queen. If the wax were removed for that purpose we do not see why the operation should not be confined to that part through which she makes her escape. On the other hand, if from the wax of the royal cells being thicker than it is in other parts of the comb, the workers are induced to make excavations, and desist only upon the thickness being reduced to that of the ordinary partitions, it follows that it will at last become uniformly thin, as described by Huber; the reason here given differs from Huber's, but we think is more in accordance with the habits and economy of the animal.

In forming the cells, a hollow is first excavated on one side of the wax-block; this excavation is rather less than the width of a cell, and is immediately followed by two of a similar description on the opposite side of the block. The particles of wax removed in excavation are kneaded by the jaws of the bee and deposited on the edges of the intended cells; the two latter excavations (*b*, *b*, Fig. 3639) are necessarily on each side of the first, though close to it. In placing the two last-men-

* A queen whose pairing is retarded beyond the 28th day of her whole existence, lays only male eggs; and is useless. In ordinary cases, she first lays neuter and female eggs. When pairing at the proper age takes place late in the season, the queen does not begin to lay till spring; she lays about two hundred per day, or twelve thousand (a swarm) in two months.

* If we allow that the basis of the work of the hive-bee be circular, the royal cell forms no exception to the general rule, so far as the principle of its construction is concerned.

tioned cells, the bees avoid the opposite part on account of the thinness of the wax, and the size of the wax-block will not admit of their being remote from the first.

Supposing the parts at which the circles nearly come in contact with each other to be of the thickness proper for the partitions of the cells, the parts marked *a* in the front view and section (Figs. 3640 and 3641) being more than the necessary thickness, the bees will (according to the instinctive principles before mentioned) naturally remove what is there superfluous, thus forming an angle, determined by two intersecting vertical planes, at the bottom of the cell; inasmuch as at the same time the parts marked *b*, in the back view and section (Fig. 3641), will also be removed. The partition between these two last-mentioned cells thus becomes perpendicular and of equal thickness, and is exactly opposed to the angle at the bottom of the first cell.

By this time the necessary secretion of wax has taken place in all the bees composing the festoons, and they are all anxious to dispose of their scales of wax. The sculpturer-bees are also active, consequently more wax is added to the margins of the original block, and more excavations are formed. Supposing the block to have increased to double its original length and width, there would then be room for parts of four more excavations, on the side on which the first was made. (See Fig. 3642.)

The same operation of reducing the wax in the thick parts marked *c*, having taken place, the sides of the first cell also become straight and perpendicular, and by reducing the wax at the parts *d*, to the proper thickness in all the cells, the bottom of the first cell, and upper parts of the two cells beneath, in the diagram, become two-sided. The work on the opposite side of the comb being in the same state of forwardness (for after the commencement it proceeds equally at all parts), will appear as in Fig. 3643.

Figs. 3644 and 3645 show the progress of the cells from their foundation to their completion.

In Fig. 3646 the angles at the bases of the cells are cut into the partitions of the opposing cells, and hence it is clearly seen that, from the position of those cells, the perpendicular partitions of the cells on this side must be longer than those of the other, and that the cells themselves must have three quadrilateral plates for their bases.

In carrying up the sides of the cell, the form is regulated by the intersection of the surrounding circles, as represented in Fig. 3646. But the circles described in this figure, parts of which are shown in most of the others, represent those which are enclosed by the hexagons, whereas we believe the natural circumference of each cell (supposing it to be cylindrical) is that by which the hexagon is enclosed: hence it will be necessary to imagine the circles partly intersecting each other.

It has now been demonstrated that the cells of the first tiers on each side are pentagonal; that the bases of those on one side are each composed of two plates, while those of the other side are each composed of three plates; and that, according to the laws laid down, they could not have been otherwise: now as this accords with all the accounts given of the proceedings in the construction of the comb, it seems to prove that the laws which we have laid down, as guiding their formation, are correct.

The ordinary cells of a comb are of two sizes; those designed for the male larvæ being rather larger than those of the ordinary size in which the neuter larvæ are reared. The width of the former cells is about three and one-third lines, and that of the latter two and two-fifths. A comb is always commenced with the small-sized cells. Hence, when the larger cells are constructed, instead of being opposed to three others, they encroach upon a fourth, and their bases are consequently composed of four plates instead of three: at first a minute lozenge-shaped piece is visible at the top of the basal part (Fig. 3647, *a*); this gradually increases in size as the one on the opposite side, *b*, decreases. When the full size of the cell is attained, the top and bottom pieces (*c*, *c*) are equal; but as soon as a sufficient number of the larger cells is formed, the lower lozenge gradually decreases, while the upper one (*e*, *e*) increases in size, until there are but three plates again visible (*d*, *d*).

During the progress of the comb in building, various accidental occurrences may interrupt its uniformity and disarrange the whole. Fig. 3648 shows a sectional view of the combs of two hives, which have suffered general disarrangement.

According to Kirby the worker-bees are annual insects, but the queen will live sometimes more than two years: but he adds that their destruction is cruel and unwise, as every hive consists of young as well as old individuals.

Fig. 3649 represents a large pyramidal hive planned by Réaumur; from experiments with which he ascertained that want of room was not the cause of the emigration of swarms; no doubt it is the mode appointed for the extension of colonies of this insect, and that an instinctive feeling impels to it.

We can scarcely regard the hive-bee as at present existing in a wild state in our island, or indeed in Europe; for though swarms often escape and tenant cavities in buildings, vacant spaces under the roofs of buildings, and the like, yet they never appear to extend their colonies, and establish themselves in our woods, or among the recesses and fissures of our rocks: other species however are abundant, to some of which we have already alluded; we mean those that are solitary in their habits, the female being the worker, as well as the parent of the brood. But there are others which, like the hive-bee, are social in their habits, though the numbers forming a single settlement are by no means so great as those of the crowded hive. The humble-bees are of this description.

All are familiar with the common humble-bee (Bombus terrestris). From spring till late in summer we see it wandering over clover-fields and through gardens, busy with every flower, and assiduously probing their nectaries. If it be patiently watched, it may often be traced to its retreat, where it has laboured in constructing cells and storing up honey. The domicile of the Bombus terrestris is a simple excavation in some bank, a little chamber of about six or eight inches in diameter, to which leads a long winding passage capable of admitting the ingress and egress of two bees at a time. The population seldom exceeds one or two hundred, and may be divided into females, males, and workers. The females are of two sorts—very large, and small. The large females, or queens, look like giants compared to the smaller females and workers or neuters; they produce males, females, and workers; but the small females produce only male eggs. The large females therefore we may regard as the founders of every colony. They emerge, in an established colony, from their pupa state in the autumn, and pair in that season with males, the produce of the small females which have previously acquired their due development. On the approach of winter, these large females (there is no queen paramount), retire, each to a little snug apartment lined with moss or grass, and separate from the general vault, passing the cold season in a state of torpidity. Early in the spring they awake, issue forth, and take different directions, seeking for some convenient spot in which to begin their labours, and at this time may be seen exploring every hole or crevice in banks or on the ground. We will now suppose one of these queens to have formed or enlarged a chamber, and established herself. She begins to collect honey and pollen, and constructs cells in which her eggs are to be deposited.

So rapidly are the latter built, that to make a cell, store it with honey and pollen, the food of the young, deposit one or two eggs in it, and cover it up, requires little more than half an hour. Her first and most numerous brood consists almost exclusively of workers, which as soon as excluded from the pupa assist her in all her labours. Her next brood consists of large and small females, and males. These appear in August or September; but, if Huber be correct ('Linn. Trans.' vi. 285), some male eggs are laid in the spring, with those that have to produce workers. We have now, then, large and small females, males, and workers, the produce of the single queen who began to found this establishment. The workers are by far the most numerous, and to them is entrusted the reparation of the cells and the spreading of wax over the roof. When in any of the cells one of the larvæ has spun its cocoon, and assumed the pupa state, it is their duty to remove all the wax away from it; and after the pupa has attained its perfect state, which takes place in about five days, to cut open the cocoon that the perfect insect may emerge from its imprisonment. It is theirs moreover to supply the young grubs with food, after they have consumed the stock deposited with each egg in the cell, and regularly feed them with honey or pollen, introduced through a small hole in the cover of each cell, opened as occasion may require and carefully stopped up again. As the grubs increase in size, the cells which respectively contained them become too small, and split by the struggles of their inmates; the breaches thus produced they repair with wax as fast as they occur, attentive to see where their services are required; and it is in this manner that the cells gradually acquire an increase of size to accommodate the increasing larvæ. Besides these duties, in chilly weather and at night the workers brood over the pupæ shrouded in their cocoons, in order to impart the necessary warmth. In some nests there are from forty to sixty honey-pots, the cocoons of bees recently emerged from their pupa condition, and sometimes half of these are filled in a single day. It must not be supposed that the interior of the nest presents the same appearance as that of a bee-hive. Instead of vertical combs of wax with hexagonal cells, we see either a single cluster of cells, or a few irregular horizontal combs placed one above another and supported by pillars of wax. Each layer consists of several groups of oval yellowish bodies, of three different sizes, those in the middle being the largest; the whole slightly joined together by a cement of wax. These oval bodies are the silken cocoons spun by the larvæ; some are closed at the upper extremity, others open: the former are those which yet contain pupæ; the latter the empty cases from which the young bees have escaped. Besides these there are the cells of wax, in which are eggs and a store of pollen and honey, but from which in due time the workers will remove the wax, the larvæ having completed their cocoon. There are moreover the honey-pots, that is, the relinquished cocoons patched up and strengthened with wax, sometimes also vessels of pure wax filled with nectar.

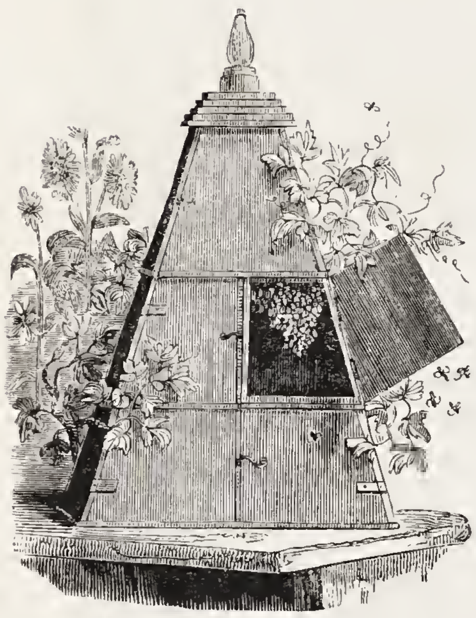
From the workers let us pass to the mother-queen and inquire into her duties and actions. We must suppose her surrounded by the workers, who watch all her movements. She is about to deposit in the cells the eggs from which the second brood is to spring; actuated by some instinctive impulse, the workers endeavour to seize the eggs as soon as laid and destroy them, perhaps in order to keep the population within due bounds. Be this as it may, the female has to exert herself to the utmost to prevent her eggs from being all devoured, and it is only after she has driven them back several times and routed their forces that she succeeds in accomplishing her purpose. When she has deposited her eggs in the cells, with a store of food, and closed them up with wax, she has still to keep vigilant watch over them for six or eight hours to prevent the assaults of the workers. After this period, strange to say, their nature seems changed; they no longer evince any appetite for devouring the eggs, and the female gives up her charge, committing all to their care. From these eggs proceed a few large females, to be at a future day the founders of colonies, a few males, and a few small females closely resembling the workers, but attended by the males, which form their court. And now, as Huber assures us, the whole establishment is a scene of confusion; for these recently perfected small females begin to prepare cells for their eggs, and this proceeding rouses the anger of the queen-mother to the highest pitch. She assaults them with fury, driving them away; puts her head into the cells and devours the eggs, and is in turn herself assaulted and forced to retreat. They then contend amongst themselves for various cells, but after a short time tranquillity is again restored. Their produce consists only of males, which pair with the large females in autumn, the latter retiring to their hybernaculum and sleeping till spring. The males are rather larger than the small females, and their antennæ are longer and more slender. They are not an idle race, for Réaumur asserts that they work in concert with the rest, to repair any damage that may befal their common habitation. They remove every sort of rubbish, and the bodies of such individuals as may chance to die; but they do not forage for provisions. On the setting-in of winter, workers, small females, and males, and probably the queen-mother, all perish, the continuance of the race depending on the few large females reposing in their winter dormitory.

Fig. 3650 represents the nest of Bombus terrestris, laid open: *a*, male; *b*, large female; *c*, worker. Fig. 3651, the male and female.

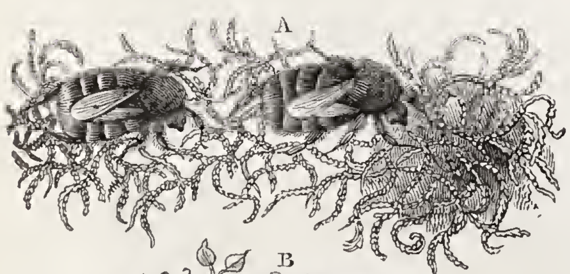
There is another species of Humble-bee, the Bombus Muscorum, which selects a shallow excavation in the earth about six inches in diameter, over which they construct a dome of moss, or withered grass, the fibres of which are intertwined, and the whole as it were felted together. Internally the dome, which is five or six inches in height, is lined with a coat of wax in order to render it impervious to rain. In collecting their materials, the bees form a file of several individuals, extending, at short distances apart, from the nest to the spot where the materials are to be obtained; the last bee disengages the moss, and having with her fore-limbs made it up into a small felted bundle, she pushes it under her body to the next in rotation; this transfers it to the next again, and so on till it is conducted to the nest. To the interior of the dome a covered way, often extending for the distance of twelve or fourteen inches, always leads; its width is about half an inch, and the passage is not more than sufficient to admit the ingress or egress of a single bee. With regard to the economy of these moss-carding humble-bees, it is precisely the same as that of the common species.

Fig. 3652 represents, at A, two of the carder-bees at work in the preparation of moss for their nest; B is an exterior view of the nest.

3653.—Carder-Bees' Nest and Cells.

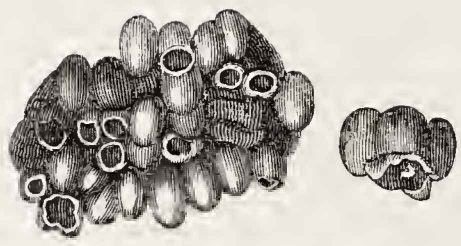


3649.—Réaumur's Pyramidal Hive.



3652.—Carder-Bees and Nest.

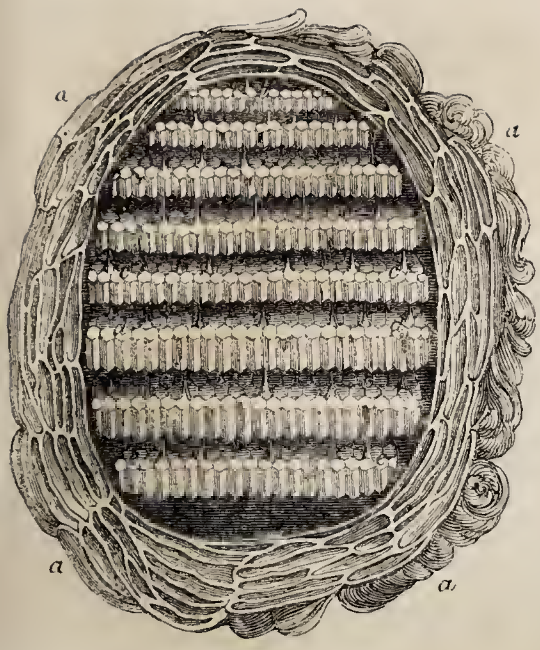
3650.—Humble-Bees and Nests.



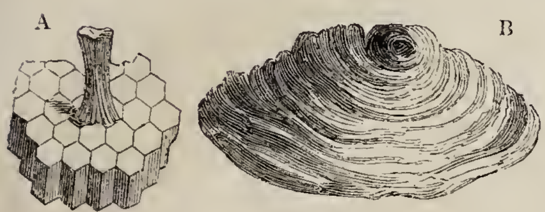
3654.—Breeding-Cells of Carder-Bees.

3651.—Humble-Bees.

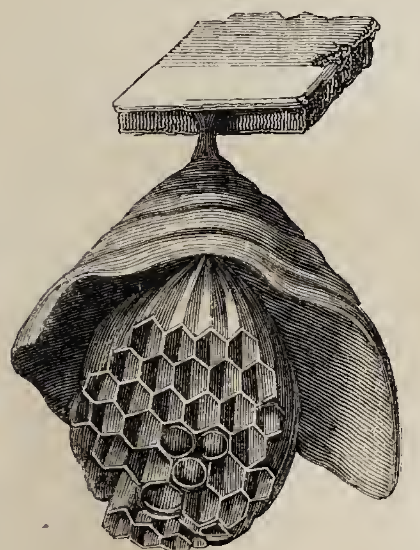
3655 – Hornets and Wasps, with Nests.



3656.—Section of Wasps' Nest.



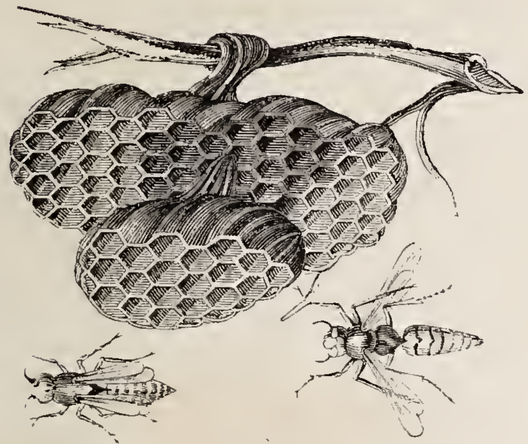
3657.—Portion of Wasps' Nest.



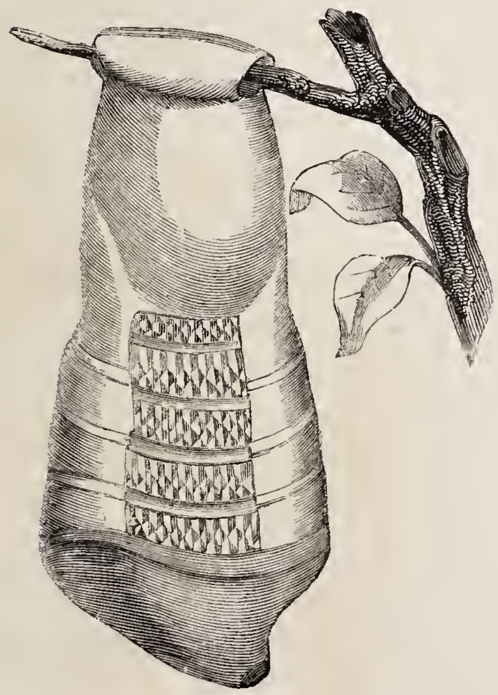
3658.—First Stage of Hornets' Nest.

3659.—Wasps' Nest.

3660.—Wasps' Nest on Willow

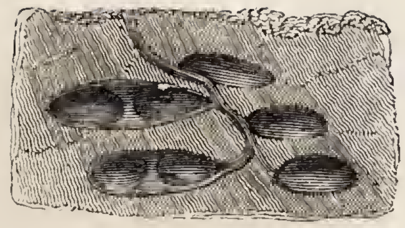


3662.—Epipone nidulans and Nest.



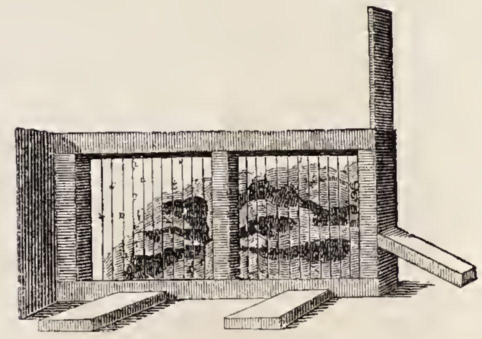
3663.—Pendent Wasps'-Nest, from Cayenne.

3664.—Tree chambered by Wood-Ants.

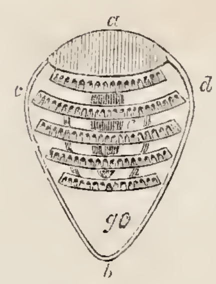


3665.—Red Garden-Ants' Nest.

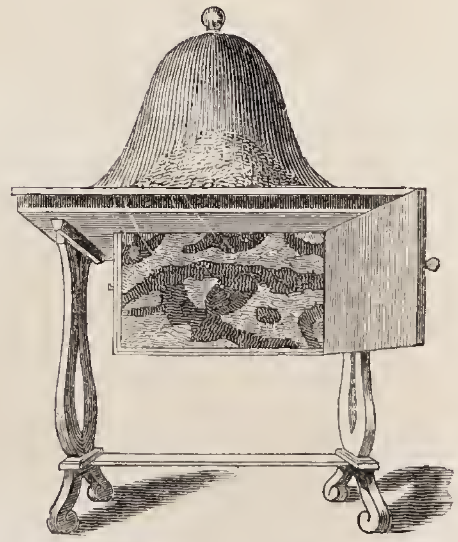
3667.—Huber's Ant-Apparatus.



3666.—Huber's Ant-Apparatus.



3661.—Section of Wasps' Nest.



3668.—Huber's Ant-Apparatus.

Fig. 3653 shows the interior of the carder-bees' nest, with the cells.

Fig. 3654 shows the breeding-cells, removed from the nest.

The Carder-bees are smaller than the common Humble-bee; the fore part of the back is of a dull orange and the hinder part ringed with different shades of greyish yellow.

From the Bee we may next turn to the Wasp and its immediate allies, of which Fig. 3655 illustrates four species, viz., the Hornet (Vespa Crabro), with the nest in the hollow of a wooden post; the Vespa Britannica and nest, at *a*; the Vespa Holsatica and nest, at *b*; the common Wasp (Vespa vulgaris), at *c*.

The common Wasp (Vespa vulgaris) is generally seen in great abundance in the autumn and latter part of the summer; and its fondness for luscious fruits, for sugar, and even for flesh, is known to all. It is very rapacious, and will attack and devour weaker insects; it is also bold in defence of its nest, or vespiary.

In many respects there is a great similarity between the operations of these insects and humble-bees.

A vespiary during the season of bustle and activity contains the following inhabitants: first, females of two sorts, a large variety, the founders of a future colony, and a smaller variety, producing, it is believed, only male eggs; secondly, workers; thirdly, males; and fourthly, eggs and young. But there is no honey, and no store of food.

Numerous as are the tenants of a vespiary, all perish when the severity of winter sets in, with the exception of a few large females, destined to continue the race. These become torpid, till revived by the warm breath of spring, when they issue forth, each taking her separate way, to be the solitary foundress of a busy colony. Various are the sites in which the queen wasp commences her settlement. Holes in banks, either formed or enlarged by herself, burrows in deep thatch, recesses under the roofs of buildings, and similar situations are appropriated. Having fixed upon or excavated a convenient retreat, she begins to construct her citadel with its arrangement of floors and cells, to be finished hereafter by her numerous assistants. What, it may be asked, are her materials? Not wax, as in the case of the bee, but paper, papier-mâché! Yes, the wasp is a paper-manufacturer, and time immemorial, ere "Greece and Rome had writ their annals," did it prepare this invaluable material, forestalling the art of man. This paper is made from the fibres of wood. The insect, by means of its strong mandibles, tears away and bites off filaments or minute fragments from half-decayed trees, from weather-worn posts, palings, or other sources of supply. Long had the material indeed, with which the wasp builds its vespiary, puzzled inquirers, and was at length by chance discovered. One day M. Réaumur saw a female wasp alight on the sash of his window, and begin with her mandibles to detach slender fibres from the wood, little more than a line in length, and gather them into a bundle with her feet, adding to it from other parts of the wood-work favourable to her purpose. He observed that she bruised each fibre, as she detached it, in her mouth; and on examining her bundle, found it composed of similar bruised portions. He imitated it by means of a penknife, and had at once a clue to the material of the vespiary. The filaments, it may be added, are carried home and masticated into a sort of pulp by the addition of a viscid saliva, which blends the whole into a ductile mass capable of being moulded or spread out as may be required; the work proceeds with great order and rapidity, each labourer having its allotted station.

To return to the solitary female: her first care is to form a number of cells, perhaps several hundreds, in which she deposits her eggs, attaching them by means of a strong gluten; in a short time a brood of the larvæ of workers make their appearance, and are assiduously fed and attended till they assume the pupa state. In a few days they come forth a crowd of obedient labourers, ready within the course of twelve hours to assist their parent queen. They soon set about enlarging and perfecting the vespiary; they construct additional tiers of cells, in which the queen deposits the eggs of females and also of other workers; they are unwearied in the care of the newly hatched larvæ, feeding them and collecting various sweets for their nutriment. They visit sugar-casks, they pillage the bee-hives, they despoil the plum-trees of their choicest produce, and on their return pass from cell to cell supplying each restless craving larva with its allotted portion. The larger grubs require more substantial nourishment; for these they bring home captured flies, and bits of meat stolen from the butcher's stall, and with these dainties feed their expectant younglings. Thus are they ever busy, for no sooner has one brood become perfected than another is in progress; hence, from being a solitary individual, the queen-mother finds herself before the close of summer surrounded by thousands.

Kirby and Spence observe that "the number of cells in a vespiary sometimes amounts to more than sixteen thousand. Each cell serves for three generations in the year, which, after making allowance for failures and other casualties, will give a population of at least thirty thousand. Even at this time, when the queen-mother has so numerous an army of coadjutors, her industry does not cease; but she continues to set an example of diligence to the rest of the community. If by accident, before the other females are hatched, the queen-mother perishes, the neuters cease their labours, lose their instincts, and die. The number of females in a populous vespiary is very considerable, amounting to several hundreds. They emerge from the pupa about the end of August, at the same time with the males, and fly in September and October, when they pair; but of this large number of females few survive the winter." It is upon these few that the perpetuation of the race depends.

We have said that the workers assist materially in the care of the larvæ, and in the extension and reparation of the vespiary; they are, in fact, the active servants of the queen. Some of them are necessarily engaged in-doors, while others are employed abroad on foraging expeditions for food. But the wants of the in-door labourers are not neglected: the foragers return, and after supplying the appetites of the larvæ, distribute the surplus, which they appear to do with great impartiality. Disgorging the saccharine juice, drop by drop, part is given to the workers, part to the females, and part to the males, and each food-bearing worker is attended by several, each receiving its ration. The males are not idle; they are labourers of an inferior class, and serve as the scavengers of the vespiary, removing all offensive matter and extraneous substances: they exceed the workers in size, but are less than the large females. So far all has gone on with order and in harmony; but October is closing, and the rigour of winter creeping on; they have laid up no store of food, and numerous cells are occupied by larvæ. It would seem as if a sudden frenzy had seized the active tenants of the vespiary; their devoted attachment to the young is changed to apparent hatred; they drag the larvæ out of their cells, sting them, and so destroy them, scattering their lifeless bodies around the entrance of the vespiary. Is it in mercy to the young that they are thus instinct-prompted to act, in order to prevent thereby the pangs of hunger and a lingering death; or has their disposition undergone a radical change? or rather, are they not impelled to it by that strange overstrained feeling of morbid anxiety for the young, which leads the rabbit and some other animals to devour their offspring, if disturbed at an early age in the nest? However this may be, thus are the larvæ sacrificed. But the death of their destroyers is at hand: with the exception of two or three large females more vigorous than the rest, all perish, and the busy, bustling vespiary, so lately the scene of industry and order, is silent. In very wet or very severe seasons the number of females which escape the common doom is less than in a mild winter, and it often happens from the vespiary becoming deluged that not one escapes the general fate. In some vespiaries, according to their situation and incidental circumstances, more females escape than in others, but in none is the number considerable.

Even in the spring, when the female is engaged with her first brood, heavy rains will sometimes flood the new and unfinished vespiary, and destroy the queen-mother and her larva progeny. It is in all probability from these and similar causes that the abundance of wasps varies in different years, their numbers being comparatively scanty during one summer, to what they are during another.

The vespiary of the common wasp is of a roundish or oval figure; externally it presents a coat of tiling, or rather, of thin overlapping pieces of greyish paper like little flat oyster-shells; these cover a number of layers (fifteen or sixteen) constituting the wall of the cell, within the hollow of which the plates of cells or combs are arranged. These in a finished vespiary are from twelve to sixteen in number, and are placed not vertically as in the bee-hive, but horizontally, the cells being on the under side of each table. These tables are not only fixed to the sides of the outer walls, but have their centre supported by suspension rods, like colonnades of pillars with the base and capital wider than the shaft. The top of each table forms a floor, where amidst the suspension rods the wasps can walk about, attending to the young in the cells above their heads, having a clear space of about half an inch from the cells to the platform. Two holes at the bottom of the nest, to each of which a covered-way leads, are the doors, one of ingress, the other of egress, and orifices admit of access from one stage to another. The whole structure is generally about three feet in circumference; we have seen larger and smaller. In the building of this beautiful structure the dome is first finished; then brought lower down and another plate added, and secured to the former by stout suspension rods. The first layer or two is the work of the solitary female; the workers in due time come to her assistance, and carry on the operations, which are not completed till the middle or close of autumn. Winter comes, and it then only serves as the dormitory of a few females. These in the spring commence the whole over again, for the same structure is never used a second season.

Fig. 3656 represents a section of the wasps' nest: *a a*, the external wall; *b*, *c c*, five small terraces of cells for the neuter wasps; *d d*, *e e*, three rows of larger cells for the males and females. Fig. 3657 represents—A, one of the rods from which the platforms are suspended; B, a portion of the external crust.

The hornet (Vespa Crabro) builds essentially the same kind of structure as the wasp, but of a coarser material: the colour of the papier-maché is generally of a yellowish brown. This insect often takes up its situation in the hollows of logs or decayed trees, which it enlarges to suit the size of the vespiary. The strong mandibles of the hornet enable it to work with facility not only upon the soft wood, but even, as Réaumur says, to bore a winding way to the nest through the solid and undecayed substance of the tree. It is not, however, always that the hornet builds in the hollows of trees; it often rears its vespiary in thatch, or under the tiles of old barns and outhouses.

Fig. 3658 shows a hornets' nest in its first stage. There are two species of wasp, Vespa Holsatica, Fabr., and Vespa Britannica, Leach, (if indeed they be truly distinct,) which build a pendent oval vespiary with a smooth outside, attached to the branches of a shrub or tree; the aperture is at the pendent apex. Mr. Shuckard says that the nest of Vespa Holsatica is much larger than that of the other, and that in the north they often occur in gardens fixed to gooseberry bushes. It was in a gooseberry bush, in a garden at a little distance from Buxton, in Derbyshire, that we ourselves observed the nest of one of these wasps. It was pendent, and loosely constructed externally of foliaceous layers. Mr. Shuckard closes his observations by saying: "I strongly suspect that the Vespa Holsatica and Vespa Britannica are identical." ('Mag. Nat. Hist.,' 1839, p. 458.) Fig. 3659 shows the section of a nest of Vespa Britannica. Fig. 3660 represents the nest of this species, or of Vespa Holsatica, attached to the branch of a willow. Its length was between nine and ten inches, and it contained five platforms of cells, as seen at Fig. 3661, showing a section: the entrance is indicated by the letter *g*; *a*, the top; *b*, the pendent extremity; *c d e*, layers of cells.

There are certain wasps, of the genus Epipone, which form terraces of cells, not unlike those of the common wasp, but without the protection of an outer wall, and quite open to the weather. Swammerdam found a nest of this description attached to the stem of a nettle, and Réaumur describes them as fixed to the branch of a thorn, to shrubs, and even to stalks of grass. Fig. 3662 shows Epipone nidulans, and nest.

Among the most interesting wasps' nests which we have seen and examined is one of a species in South America; it is pensile, and suspended from the branch of a tree; its shape is like two cones base to base, but of different lengths, the shorter cone pointing downwards. Its external wall is composed of stout, tough, white cardboard, which takes ink from a pen extremely well; it is smooth, and of a close texture. The aperture for admission is at the lower apex; the length of the specimen we measured is nine inches; the circumference at the widest part, where the two cones meet, about eighteen inches. Internally, six stout platforms stretch horizontally across; they are smooth above, with hexagonal cells below. These platforms are not, however, flat, but rather concave above, like a watch-glass reversed. The centre of each is perforated for admission at the extremity of a short funnel-like projection, and by these apertures access is gained from story to story; the whole, in fact, is a masterpiece of workmanship and an exquisite display of the results of instinct. We have seen some not quite so symmetrical as the specimen described, but in other respects the same. Fig. 3663 represents one of these pendent wasps' nests, from Cayenne; a portion of the side wall is cut out, to show the interior.

The European wasps are not storers of honey; but this rule does not apply to certain foreign species. In the 'Mag. of Nat. Hist.' 1841, the nest of a honey-wasp is described and figured. The species is new, and from South America. Its describer, Mr. A. White, has given it the scientific appellation of Myraptera scutellaris, and observes that it is the same as that of which Azara gives so many interesting details under the name of the "Chiguana Wasp." The general form of this nest, which is suspended to a slender branch, is ovate; its external wall consists

of stout cardboard, thickly covered with conical knobs of various shapes, which are firm and solid. Its inner structure bears great resemblance to that of the last described, but the doors of access from story to story are at the side of each platform. The external entrances are protected by knotted pent-roofs, as a security against rain; the combs or platforms are fourteen in number, and many of the cells were found to contain honey, but time had rendered it nearly tasteless (p. 315 et seq.). Besides the species belonging to this nest, several other South American wasps store honey, as was observed by Azara, and also by M. Auguste de St. Hilaire. The latter naturalist found, as he states, near the river Uruguay, an oval grey-coloured nest, of a papery consistence, like that of the European wasps, suspended from the branches of a small shrub, about a foot from the ground. He and two attendants partook of the honey, which was of very superior flavour, but which produced poisonous effects on all three. The insect he named Polistes Sechequana ('Ann. des Sc.' 1824, vol. iv. p. 335; and also Mr. White's paper above referred to). We may observe that the honey of bees where poisonous plants abound has been known to produce deleterious effects; but whether the honey of the wasp in question was noxious merely by accident, or whether such is always its nature, does not appear to be ascertained. From social bees and wasps we pass to another family of insects, the labours and instincts of which are well worthy of consideration. We allude to ants, of which several species are indigenous in our island.

We need not say that these insects are gregarious, multitudes uniting in the construction of nests or dwellings, and in various works for the common good.

The inhabitants of an ants'-nest consist of males, females, and workers; besides eggs, larvæ, and pupæ. The males and females have, when they first emerge from the pupa state, four delicate transparent wings; the workers, or neuters, which are really imperfect females, never have wings; in some species the neuters are of two dimensions, some greatly exceeding the others in bulk, as in Formica rufa and F. flava, but the duties which devolve upon them do not appear to differ: they defend the community, they nurse and feed the larvæ, they forage for provisions, they form roads, they build and repair the nest or formicary, they guard the queens and attend to their wants; and in some cases they assemble for the purpose of carrying on a warfare against the tenants of other settlements.

Various are the modes in which the different species construct their cities. The Turf-ant (Formica cæspitum), a small dusky brown species, frequent in commons and fields, is usually found to select a tuft of herbage or long grass, the stems of which serve to support the top and walls, while the blades spread over it. The structure of this tenement is very slight, and consists of small grains of earth, piled up without any other cement than water, or the dew and moisture of the ground, which produces a sufficient degree of adhesion between the particles. We have seen it made almost wholly of grains of sand, which were so skilfully arranged as to retain their position. Internally are galleries and various chambers.

The yellow ant, Formica flava, uses the dust of decayed wood or particles which it gnaws from mouldering logs or trees, and mixes this material, by means of its mandibles, with earth and spiders' webs, and with these materials it builds the chambers, stages, and galleries of its edifice.

The nest of the fallow-ant, horse-ant, or wood-ant (Formica rufa), the largest of our British species, and not uncommon in woods and pleasure-grounds, presents a rude appearance; externally it seems nothing more than a hillock of sand and earth, with bits of wood, dried particles of leaves, portions of twigs, and even grains of corn, all as it were mixed together, and forming a mound of considerable size. Internally it contains numerous chambers, arranged in separate stories, some deeply excavated in the earth, others near the centre and even near the surface of the hillock, and communicating with each other by means of galleries; several passages lead to the outside, the entrances being kept open or closed according to the state of the weather.

The red ant (Myrmica rubra), common in gardens, makes burrows and chambers under stones or in the ground.

The brown or ash-coloured ant (Formica fusca) makes storied habitations of clay, in which it shows equal ingenuity and industry.

The societies of the fuliginous or jet ant (F. fuliginosa) make their habitations in the trunks of old oaks or willows, in which, with their strong mandibles, they work out horizontal galleries, separated from each other by thin partitions, and communicating with each other. Sometimes these excavations look like halls supported by rows of pillars, rising story above story, presenting a delicate and elaborate specimen of carved-work stained black; but whether from exposure of the wood to the atmosphere, or from some emanation from the ants, or the action of formic acid—a peculiar secretion found in these insects, is not apparent. Fig. 3664 shows a portion of wood chambered by these ants.

Fig. 3665 represents a section of the chambers and gallery of the red garden-ant, which often makes its nest under garden-walks.

Figs. 3666, 3667, and 3668 represent various sorts of apparatus used by Huber for studying the habits of these insects; they are artificial formicaries. Many ants, in the warmer parts of the globe, make wonderful structures, which have attracted the notice of travellers. Malouet saw, in Guiana, ant-hills from fifteen to twenty feet in height, and from thirty to forty feet in circumference at the base, but was deterred from approaching them within forty paces by the fear of being devoured. Stedman, when in Surinam, passed ants' nests six feet in height, and one hundred in circumference. Mr. Darwin says, "A person, on first entering a tropical forest (in South America), is astonished at the labours of the ants; well-beaten paths branch off in every direction, on which an army of never-failing foragers may be seen, some going forth, others returning burdened with pieces of green leaf, often larger than their own bodies." Dampier describes a small yellow ant of South America, whose sting is like a spark of fire, and which makes nests in great trees, placed on the trunk between the large bifurcations, often equalling a hogshead in size; these nests are their winter retreats; great paths through the woods, of the breadth of four inches, are trodden by them, and thousands may be seen returning with portions of green leaf so large that he could scarcely see the insect for its burden: the path looked like a moving line of green. In Australia a species of ant builds a curious nest by bending down several adjacent leaves, and gluing them together so as to form a purse; they sting with great severity. Another species, of a black colour, in New South Wales, excavates the branches of trees by working out the pith almost to the extremity of the slenderest twig—the tree at the same time flourishing as if it had no such inmates; on breaking off a branch the traveller is covered with them, and also experiences their stings. Other species, again, make huge nests of clay in the trees, conspicuous at a great distance.

To return to the European ants. If in the month of August or September an ants'-nest be watched some glowing day, thousands of winged ants will be seen issuing forth, rising in the air with a slow movement, and settling on gates, stones, and posts. These are the males and females, which have just emerged from the pupa state, and attained their complete development. Astonishing clouds of these are sometimes seen:—the swarms of a whole district seem to assemble together, and rise in the air like columns of vapour, whirling and twisting about as the living myriads composing the mass change their position. Various instances of this extraordinary swarming of ants are on record; but want of space precludes our citing them. It is now that the males and females pair; and were it not for the destruction that takes place, greatly reducing the numbers of the females, ants would become one of the pests of mankind; as it is, in some countries they are sufficiently obnoxious. Birds prey upon them, and myriads are driven into rivers, ponds, and lakes. With respect to the males, the end of their existence being accomplished, they all perish; they have neither sting for defence nor strong jaws for needful labour and the acquisition of food. All the females, which may be known by their size and the expansion of their wings, and all the males, do not leave the original nest; or if they do, the workers scatter themselves abroad in quest of fertile females, and taking them prisoners, reconduct them to the nest, dragging them along by force, and vigilantly guarding them, lest they should escape, which they seem always disposed to do. In a short time they lose their wings, which either fall off, or, as Huber says, are purposely plucked off, and the process of laying the eggs commences. Numerous females, however, escape, and become the founders of distinct colonies. They lose or tear away their wings, construct a cell, lay their eggs, and are soon accompanied, as in the case of the wasp, by a crowd of workers.

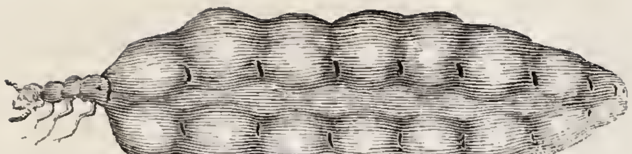
With respect to the imprisoned females, of which there are sometimes several in a single nest, they are attended each by a worker, who supplies their wants. They exhibit no rivalry, but crowds follow in their train; and when they lay their eggs these are taken by the workers, and arranged in the chamber she is at the time occupying. According to Huber, when a female is acknowledged as a parent, the workers begin to pay her homage, very similar to that which the bees render to their queen; they press round her, offer her food, conduct her by her mandibles through the labyrinthine galleries, and carry her over the steep and difficult passages, while she coils herself up, so as to incommode her bearers as little as possible. "In whatever apartment," says Mr. W. Gould ('Account of English Ants,' 1747), "a queen condescends to be present, she commands obedience and respect. A universal gladness spreads itself through the whole cell, which is expressed by particular acts of joy and exultation." "She is generally encircled by a cluster of attendants, who, if you separate them from her, soon collect themselves into a body, and enclose her in the midst." According to Huber, even if she dies, they sometimes continue for months the same attention to her; brush her, lick her, and treat her with the same courtly formality as if she were alive.

But there are other duties to which the workers have to attend. The minute eggs, scarcely perceptible by the naked eye, which the females lay from time to time, are carefully collected and moistened by the workers (a plan which seems necessary to their development), and laid in heaps in separate apartments, or carried from one to another, as they may require a warmer or a moister situation, or as the weather may render needful. In a few days the young grubs are disclosed, and require the most unremitting care. Not only have they to be fed, and to be removed on the approach of evening to the lower range of cells, and in the sunny morning to those above, that they may enjoy the genial warmth; but upon every vicissitude of weather, a shower, or approaching storm, they require some change of situation, which renders the colony a scene of bustle and excitement. The devotion of the workers to the helpless larvæ is indeed extreme, and they spare neither labour nor their own lives in the care and protection of their charge. The larvæ of most species, when fully grown, envelop themselves in a cocoon of silk, and so assume the pupa state; and still, however, they require the same attention as previously, while other eggs and larvæ at the same time demand their services. During all this time the settlement has to be kept clean and in thorough repair; fresh additions have to be made, and food has to be found and brought in.

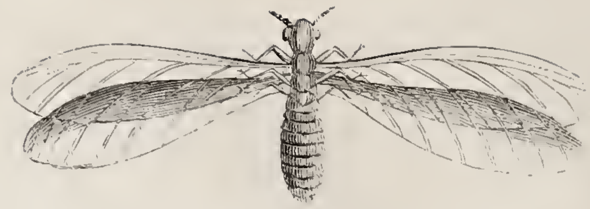
When the development of the perfect insect is at hand, the aid of the workers is again in requisition. They have an instinctive knowledge of the precise moment when the insect inclosed in its shroud requires their aid in effecting its liberation. Three or four mount upon one cocoon, and gradually and carefully open the silken envelope where the head lies, and gently extract the prisoner. It is still enwrapt in a thin delicate pupa-case, and they carefully and cautiously free it from this slough, clearing the wings of the males and females, and the limbs of both these and the workers. The new-born brood is still watched and fed, till the workers acquire strength and intelligence, and the males and females are ready to take wing. Some of these latter are detained, or, as we have said, captured; but the greater number take their flight, the females founding other colonies. In the case of a female founding a colony, she has to undergo most onerous duties; for unless she can attract a few stray workers to assist her, she has to attend to her first young brood herself; these, however, are mostly, if not exclusively, workers, and destined to take the burden and toil from off her hands for the future.

We cannot doubt that ants are capable of communicating their wants and desires to each other. Were this not the case, there could be no order in the community. They are ever using their antennæ, touching each other with them in various ways, and appear thus to have a certain set of signals, universally understood by the species. They exhibit great attention and sympathy towards the wounded of their own colony, assist each other in difficulties, or in carrying or dragging heavy burdens, and appear to demonstrate pleasure on meeting their comrades after absence.

The food of ants is various, and consists alike of animal and vegetable substances; they are extremely partial to saccharine matters, and to ripe fruit, as plums, &c.; but they do not hoard up grain for winter use, as has been long believed, for they pass the cold season in a state of torpidity; but as long as the temperature is moderate, they pursue their usual avocations. But though ants do not form magazines, they act in a still more extraordinary manner, which, were not the facts attested by the highest authorities, might stagger the most credulous. It is well known that a sweet juice, called honey-dew, exudes from the bodies of the aphides; and of this saccharine exudation the ants are very fond. In fact, as Kirby and Spence say, the aphides are their milch-cattle, which willingly render to them their liquid honey. They dispute among themselves for the possession of these aphides, and a colony often claims a right to the aphides of a neighbouring plant or tree, and resists the attempt of any other colony to poach on their manor. Sometimes they enclose a group of aphides, on a branch, within a cell of earth, and keep them in a sort of stable or cow-house, as their exclusive property. The yellow ant is stated to be one of the species most noted for this kind of farming. It makes a mound-like nest in the fields, and, desirous of having a herd of its milch-cattle ready at hand, collects them in its under-



3671.—Termite Queen distended with Eggs.

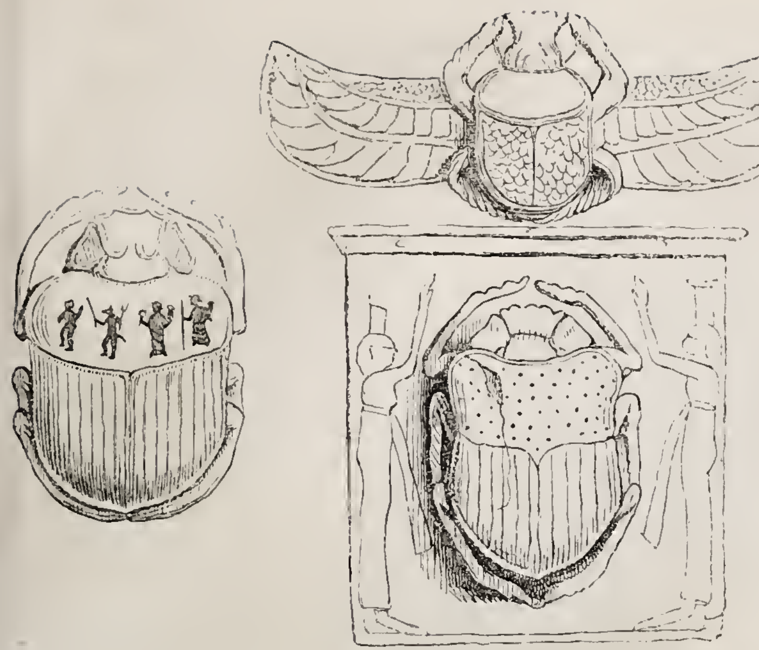


3670.—Termes bellicosus, in winged state.

3669.—Ants and their Structures.

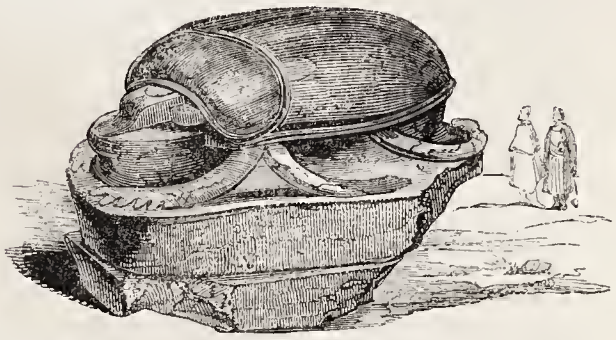
3673.—Turret Nests of White Ants

a b 3672.—Nests of Termites. c



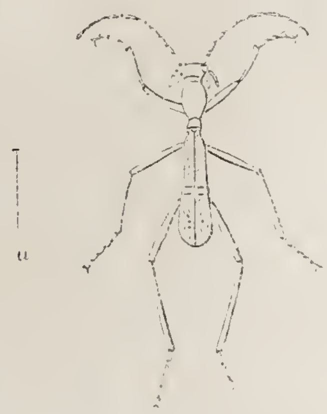
3674.—Scarabæi from Egyptian Monuments.

3685.—Glowworms.



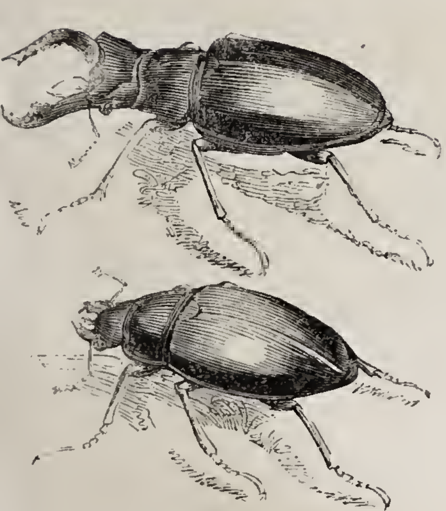
3675.—Colossal Scarabæus.—British Museum.

3679.—Brentus Temminckii.



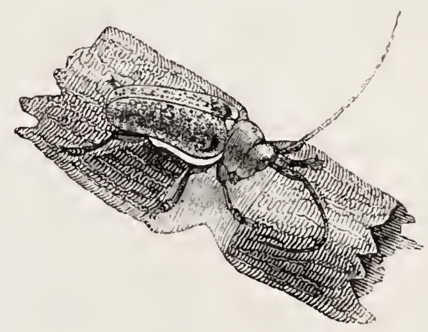
3680.—Ctenosoma macilentum.

3681.—Calathus latus.



3676.—Stag-Beetles.

3682.—Calosoma sycophanta.



3677.—Capricorn Beetle.

3678.—Nut-Weevil.

3683.—Blaps obtusa.

3684.—Lagria hirta.

ground stables, in great numbers, and not only those which are full-grown, but the eggs and young, which are carefully nursed and attended to. Huber says that in a nest of the yellow ant, at the foot of an oak, he once found the eggs of the aphis peculiar to that tree (Aphis Quercus).

Emigrations of ants, from some cause or other, often take place. In our country the fallow-ant (F. rufa) is the most noted for this procedure; but in hotter countries many species perform migrations, and in vast armies traverse whole districts, and ravage the land as they proceed. Professor Afzelius, speaking of a species at Sierra Leone, states that they march in columns, exceeding all powers of calculation; and always pursue a straight course, from which nothing causes them to deviate. If they come to a house, or other building, they either storm or undermine it; if a river opposes them, though millions perish in the attempt, they perseveringly endeavour to cross it.

Wars often take place between colonies of different species, and sometimes between rival colonies of the same species. Generally, however, colonies of large ants are the aggressors upon those of a smaller species, who, nothing daunted, meet their oppressors in determined conflict, and by dint of superior numbers not unfrequently remain masters of the field.

Rival colonies of the fallow-ant (F. rufa) occasionally engage in battle, and Huber details the conflict as one of determined obstinacy on both sides; the fury of the combatants preventing them from paying attention to human spectators. Thousands of champions engage in single combat; thousands rush to the mêlée; every individual knows the combatants on its own side, and the strife rages till night puts an end to the carnage. The next morning it is renewed, and often for several days in succession. The prisoners, it would seem, are dragged to the hostile encampment and killed. Thus, like the rival squadrons before the walls of Troy, do they feel the "certaminis gaudia;" and if no Muse has celebrated the Myrmidonomachia, as Kirby and Spence well term it, nor described in verse the exploits of a mimic Hector, Achilles, or Tydides, it is because valour meets not always with a bard:

> "Vixère fortes ante Agamemnona
> Multi; sed omnes illachrymabiles
> Urgentur ignotique longâ
> Nocte; carent quia vate sacro."
>
> HORACE.

But certain ants undertake proceedings which, though involving combats, are conducted for other purposes than the mere gratification of revenge—proceedings so strange, that had not Huber, Jurine, Latreille, Kirby and Spence, either witnessed them or had proof positive of the facts, we might treat the whole account with ridicule.

There are two species of ant common on the continent, but which are not found, or are very rare, in our island; they are called Legionary ants: one, the rufescent ant (F. rufescens), the other the sanguineous ant (F. sanguinea), and it is to these that the account relates. The colonies of most ants consist of an assemblage of the same species, but in these instances the general rule is set aside; for the workers or neuters of these ants procure, by force, auxiliaries or slaves of the same caste as themselves, but of a different species, for the purpose of availing themselves of their labour. The enslaved ants are of two species—a black ant (F. fusca), and a mining ant (F. Cunicularia).

From the form of their jaws, says Latreille, and the accessory parts of their mouth, it is impossible for the rufescent ants either to prepare habitations for their family, to procure food, or to feed them; and thus necessity induces them to make slaves of others. The rufescent ants do not set forth on their expeditions, which are kept up for about ten weeks, till the males are ready to emerge at the perfect state; and "it is very remarkable that if any individuals attempt to stray abroad earlier, they are detained by the slaves, who will not suffer them to proceed—a wonderful provision of the Creator, to prevent the black colonies from being pillaged while they contain only a male and female brood, which would be their total destruction, without bringing any advantage to their assailants, to whom neuters alone are useful."

The time of issuing forth is from two in the afternoon till five, during fine clear weather. The army proceeds in a dense column, which winds through the grass to the distance of thirty or forty feet from the habitation whence they have issued; they then scatter themselves abroad, exploring the ground with their antennæ, in order to detect the traces of the negro race; the negro village is soon discovered; its inhabitants, aroused to a sense of their danger, rush out to defend the precincts; the battle rages, but the besiegers prevail; pressing onwards they drive the negro population to their village and enter with them or make breaches in the walls; the fugitives seek the lowest story; the pillage commences, and soon the army in triumph returns laden with spoil, each warrior having in its mouth a captive larva or pupa, which it brings home to slavery.

Their assault upon the habitation of the mining-ant, which, when they cannot meet with that of the black ant, they resolutely attack, is a more difficult affair. The miners fight with desperation, and dispute every inch of their territory, defending their progeny to the last; and when the rufescent retire laden with their captives, they harass their rear, and for a considerable distance keep up an incessant skirmish.

The excursions of the sanguineous ants are managed somewhat differently; they sally forth in small bands, which are reinforced from time to time as necessity may require, and are often kept at bay by the resolute negroes, till at length a large column arrives to their support; frequent skirmishes precede a general battle, the negroes forming a body to receive the assault. The combat is often for a long time dubious; at last, repulsed on every side, the black population retreat, and endeavour to carry off the pupæ which they have previously heaped together; the assailants pursue, and force their charge from them; while some enter the village and seize all the larvæ they can find there.

In both instances, these nursling captives (for the adults are never taken prisoners) are carried home and trusted to the care of neuters of their own species that have been, like them, captured when young, and to the duties of which they will in turn succeed. By the slaves thus obtained, and which are by no means ill-treated, not only the young prisoners of their own race are nursed, but also the young of their masters; they labour in every respect the same as they would have done in their native colony, excepting that they have to bring food to their masters, and carry them from chamber to chamber; for these war-like ants, as we see among savage tribes, brave as they are in combat, are indolent in the extreme, and, moreover, in the case at least of the rufescents, are really dependent upon their slaves. Where the slaves consist of a mixture of black ants and miners, they share the labours of the community between them; and often far outnumber their masters, whom on some occasions they seem rather to command than obey, even to the extent of manifesting their anger to any that happen to return from a predatory excursion without a captive. The fact is, that though captives in the first instance, the black ants or the miners are really the masters and preservers of the rufescent colony, and looked up to accordingly. For the sake of experiment Huber "shut up thirty rufescents with larvæ and pupæ of their own kind, and several negro pupæ, in a glazed case, excluding any neuter slaves. Incredible as it may appear, they made no attempt to feed themselves, and though at first they paid some attention to the larvæ, carrying them about, they soon laid them down. Most of them died with hunger in two days, and the few that remained alive appeared weak and languid. At length, commiserating their condition, Huber admitted a single negro, and this active little slave by itself re-established order, made a cell in the earth, collected the larvæ and placed them in it, assisted the pupæ that were ready to be developed, and preserved the life of the neuter rufescents that still survived." With regard to the sanguineous ants, they are much more active than the rufescents: they assist in the in-door labours of the colony, in the collection of saccharine juice from aphides, and in the repairs of the habitation; they hunt also for a small species of ant on which they feed, and which they drag for slaughter to their fortress. They are the first to rouse in defence of the community, and in times of danger or before an engagement carefully place their faithful slaves in the lowest chambers of the nest, as places of the greatest security.

Such, then, is a sketch of the general habits and instincts of some of the more remarkable of our European ants, which are detailed more at large by W. Gould, Huber, Kirby and Spence, and others. In some respects the economy of these insects is more surprising than that of bees or wasps, and demonstrates the energy and elevation of that ruling principle which impels them to acts we might attribute to reason, to operations we might be pardoned for questioning, but which it is proved they accomplish, displaying in their undertakings perseverance, industry, and well-directed co-operation. Fig. 3669 represents several ants and their structures: *a*, fuliginous ants' nest in a tree; *b*, the fuliginous ant; *c*, the yellow ant, and nest; *d*, the fallow-ant and nest; *e*, nest of the yellow ant built over the margin of a streamlet, as observed by Mr. Sly; *f*, Formica emarginata; *g*, Formica ligniperda.

In most ants the workers and females are furnished with a sting; in some, however, as F. sanguinea, F. cunicularia, F. fusca, &c., there is no sting. They belong to the order Hymenoptera, as do the ichneumon-flies, bees, and wasps.

A group of insects called Termites, or termite ants, belonging to the order Neuroptera, are remarkable both for their habits and the edifices which they construct, and of which the most credible travellers in Africa, India, and South America have given us extraordinary accounts. These insects, of which there are several species (often termed white ants), are many of them social in their habits, like true ants, living together in numbers which defy calculation. Some species build firm and solid structures of clay, like towers or pyramids, as the Termes bellicosus (T. fatalis, Linn.) in Senegal. Others make galleries in the ground; some excavate aged trees, which contain within them a vast population. Some make a long covered-way spirally running up the trunk and along the branches of trees, to their city, which, as large as a sugar-cask, is supported by the branches, and is composed of particles of wood firmly glued together, as is the covered-way also.

Of the economy of the Termes bellicosus, common in various parts of Africa, Mr. Smeathman gives a full account in the 71st vol. of the 'Phil. Trans.' The houses of this termite are pyramidal, or of the shape of a pointed haycock, and ordinarily twelve feet high; they are built of firm clay, and soon covered with a coating of grass, so that a cluster of them at a distance resembles a negro village. The upper part of this huge hive, like an empty garret, is not used; but the lower part contains various chambers and galleries, all tenanted; and here it must be premised that the societies of these insects are divided into five orders or castes: 1st, workers, which are larvæ, and compose the majority of the population; upon them devolves the office of erecting and repairing the building, of collecting provision, of attending upon the queen, or female, and conveying the eggs laid by her to the nurseries, and feeding the young till able to take care of themselves: 2dly, pupæ, or nymphs; these resemble the larvæ, or workers, excepting that they present the rudiments of wings. Smeathman regards them as soldiers, but Latreille, from observations on a European species (Termes lucifugus), found near Bordeaux, considers the soldiers to be neuters: adopting his views, we may say then, 3dly, soldiers; these are less numerous than the working population, being as 1 to 100. They greatly exceed the workers in bulk, and may besides be distinguished by their large head and long mandibles; they act as sentinels and defenders of the city; they are wingless: 4thly, a single female, or queen: 5thly, a single male, or king.

The male and female have at first four wings, but these are soon lost; they have, moreover, large eyes, which in the soldiers are either very small, or wanting.

A hive of termites may be said to 'swarm' on the approach of the rainy season. The swarm consists of newly perfected males and females with expanded wings. Of these myriads emerge from the hive and fill the air, which carries them onwards and often drifts them out to sea. Birds and reptiles make them their prey, nor do the semi-barbarous tribes hesitate to add them to their fare. Smeathman indeed regards them as delicacies. Of many millions few pairs survive the general destruction, but the few that escape the various casualties which assail them are found by the workers, which traverse the ground in quest of them. As soon as the workers discover a pair, they immediately begin to protect them from their enemies by enclosing them in a small chamber of clay, the rudiment of a new colony. Here they are kept guarded, as honoured prisoners, the entrance being too small to allow of their escape. In a short time the queen enlarges very greatly, the body being enormously distended with eggs; for the reception of these the workers construct nurseries, composed of wooden materials joined together with gum and cased with clay. Magazines of clay are also constructed, and form a labyrinth of cells and galleries, and the conical or domed outer case is built up. The number of eggs laid in one season is incalculable; she lays about sixty eggs per minute, for several days in succession, and lives through two years. The young are attended by the workers, till capable of labouring in their turn, when they exert themselves in altering and adding to the building. In the centre of a maze of cells is the royal chamber, or rather state prison, in which the male and female are guarded; it was originally the centre of a small domed nest, but alterations and additions have extended the circumference of the building, and raised the dome to the height of ten or twelve feet. The termites are not only builders, but miners also. They make underground clay tunnels from their hives to various parts, many of these tunnels being as wide as the bore of a small cannon. These tunnels run obliquely three or four feet deep into the ground; some lead to the quarry of clay whence they derive the materials for the erection and repair of their dwelling. Others branch out horizontally in every direction to a great distance. Moreover they form vaulted roads above ground, conducting to different places where provisions are to be procured. These consist of particles of wood, the gum of various trees, and the inspissated juices of plants. Spiral galleries also run round the vaulted edifice, communicating with the maze of chambers and with the roads and underground tunnels.

When a termites' hive is disturbed or broken open, the workers retreat, and the soldiers rush with alacrity to the breach, their numbers continually increasing. They attack and bite with inveterate fury, and, being blind, seize everything they come in contact with. If they seize the legs of persons, as they often do those of the negroes, they make their large mandibles meet in the flesh, and will not let go their hold, even though torn limb from limb. When their disturber retires, they collect themselves and return to the citadel, and the labourers then come forward and commence repairing the damage, each bearing a load of tempered clay; and though millions are engaged at once, they appear never to obstruct each other's movements.

These clay houses of the termites are solid and strong, and last for years, generation succeeding to generation; and in order to keep up a due succession of living myriads, a male and female, at the time of the great 'swarming,' are secured and made prisoners within a royal cell. In a short time, the male, as it would appear, dies, and the female, as in the case of the founder of a new colony, commences the laying of her eggs. Thus a perpetual supply of workers or soldiers is maintained, and the loss from the departure of the winged males and females, at the periodical swarming times, counterbalanced.

Several species of termites, as Termes atrox, and Termes mordax of Smeathman, build their nests in the form of pillars of clay, with a conical mushroom-shaped capital; internally they contain numerous cells and galleries. Groups of five or six of these turrets are often to be seen in the woods at the foot of a tree; they are very strongly and solidly constructed. Fig. 3670 represents Termes bellicosus in the winged state. Fig. 3671, the queen distended with eggs. Fig. 3672, *a*, a covered-way and nest, in a tree, of the Termes aborum; *b*, a section of the great domed nest of Termes bellicosus; *c*, a nest of the same, entire. Fig. 3673, a group of turret nests of Termes mordax; one nest is represented as cut through, to show its interior.

Of the ravages made by termites in the hotter climates, travellers give extraordinary accounts. These insects destroy the furniture of houses, and even the houses themselves; books, papers, cloth, linen, boots and shoes are all devoured; shelves and wainscoting disappear before them, and the solid roof-beams are eaten through and through till ready to fall. They work insidiously in the night, and in the morning the effects of their visitation are but too manifest. Forbes (in his 'Oriental Memoirs'), Humboldt (in his 'Pol. Essay on New Spain'), Smeathman, Kæmpfer (in his 'Hist. Japan'), Percival (in his account of Ceylon), and other writers, bear abundant testimony to the terrible destructiveness of these tiny but innumerable pests.

We must not, however, linger; it is time to pass on to other groups in our pictorial cabinet.

Several coleopterous insects demand a cursory glance. From the earliest times two species of Scarabæus, the Ateuchus Ægyptiacus, according to Latreille, and the Ateuchus sacer of Olivier, were worshipped, and adopted as symbols, by the ancient Egyptians; the former beetle is of a beautiful green with a golden gloss, and is found in Sennaar. Like the rest of its tribe it encloses its eggs in balls of dung, which it rolls along by means of its hind-feet, until it has found holes adapted to receive them, or spots in which it can bury them. The Ateuchus sacer is black, with the thorax dotted with little pits. It is common in Egypt and the southern countries of Europe.

On all the monuments of Egypt the scarabæus may be seen, sometimes with the wings closed, and sometimes extended, with a ball between their fore-limbs:—charms, and amulets of gold, and precious stones, were made in the form of these insects, which were worn suspended to the neck, and entombed with the mummies; and large figures, elaborately carved in green-coloured basalt, or verd-antique, have been found in the temples and places of sepulture, occasionally adorned with hieroglyphic characters. Fig. 3674 shows four of these representations from Egyptian monuments; and Fig. 3675, a colossal beetle sculptured in greenish-coloured granite, preserved in the British Museum.

The family Scarabæidæ, including the genera into which it is divided, as Sisyphus, Geotrupes, &c. &c., belongs to the lamellicorn section of the Coleoptera, and to the same section belongs the Chaffer (Melolontha vulgaris), to the ravages of which we have already alluded. The stag-beetle (Lucanus cervus) is also within the limits of the lamellicorn section. This beetle is remarkable for the development of the mandibles in the male. Latreille says we may presume that the larva of this species, which passes some years in the interior of the oak before undergoing its last transformations, is the *Cossus* of the Romans, who regarded it as one of the delicacies of the table. Some, however, suspect it to have been the larva of a Curculio (C. coriarius). They fattened it with flour, and highly esteemed its delicate flavour. Fig. 3676 shows a comparison of the male with the female stag-beetle. Fig. 3677 represents the Lamia amputator (Cerambyx amputator), one of the 'Longicornes' of Latreille. It is very destructive to growing trees, from its habit of eating round a twig or branch, thus cutting off the course of the sap; the part above consequently perishes. The insect is represented in the act of making its circular incision.

Fig. 3678 represents the nut-weevil (Balaninus nucum), one of the Curculionidæ, a family remarkable for the shape of the head, which projects into a long snout or rostrum, bearing the antennæ, and furnished at the top with a minute pair of horizontal jaws. This instrument is used for boring into nuts and filberts, &c., while they are yet soft, and depositing an egg in the hole it has made; the larva feeds on the kernel. A shows the tip of the rostrum; magnified: *a a*, the jaws; B, side view of the same; C, larva; D, pupa.

An allied form is represented by the genus Brentus (Curculio, Linn.), in which are several insects of most remarkable form, all confined to the hotter climates, with the exception of one species, which is Italian. Of their habits little is known; they are generally found on trees, or under the bark. Fig. 3679 represents Brentus Temminckii, Klüg, a native of Java.

Of carnivorous beetles, we may notice the Ctenosoma macilentum, the example of a South American genus, of the family Cicindelidæ. This species is about half an inch in length, and of a bronzy black colour. The elytra are punctured, and have a transverse yellow band. Fig. 3680 represents the Ctenosoma macilentum; *a*, natural length.

The following carnivorous beetles are British. A rare species of the genus Calathus, family Harpalidæ, is occasionally to be met with; it is the Calathus latus: other species are common, and may be found under stones or rubbish, or by the sides of pathways. Upwards of twenty species, almost all European, are enumerated. Fig. 3681 represents Calathus latus.

A family of highly carnivorous insects are designated by the title of Carabidæ, of which the genera Carabus, Tefflus, Proceras, Procrustes, and Calasoma, contain the largest examples of carnivorous Coleoptera. The Carabus violaceus is very common; of a black colour, with violet and copper reflexions. It feeds upon other insects and worms, which it seizes with great avidity, and holds in its sharp mandibles with a tenacious grasp. Other species are the C. hortensis, C. catenulatus, C. cancellatus, &c.: upwards of 120 species have been described.

The genus Calasoma is closely allied to Carabus, and contains our finest and largest British example of the Carabidæ, viz., the Calasoma sycophanta. It is about an inch long; the head, thorax, and under parts are of a beautiful blue; the elytra green, with red reflexions; the limbs black. It is far more common in France and Germany than in England. Fig. 3682 represents this brilliant species.

We have already alluded to the Blaps mortisaga, common in grave-yards, damp and foul cellars, and dark places. It is of omnivorous appetite, and will feed on putrescent animal matters. A rather more uncommon species, Blaps obtusa, is represented at *a*, Fig. 3683; *b*, one of the antennæ magnified.

Certain Coleoptera are remarkable for the softness of the body generally, and the flexibility of the elytra, as Meloë, Cantharis, Lagria, &c. These insects are arboreal in their habits, and feed on vegetables. A species of the genus Lagria is common in our islands, frequenting wooded places, and is very abundant on the hawthorn. It is of an oval form, with a narrow head and thorax. These, as well as the body beneath, the antennæ and legs, are black; the elytra are yellowish, soft, and covered with very short down. Fig. 3684 represents this species, the Lagria hirta: *a*, natural length; *b*, one of the antennæ; *c*, tarsus of fore-limb; *d*, tarsus of hind-limb.

Leaving these examples of the more ordinary forms of Coleoptera, we may here advert to the luminosity of insects: several coleopterous insects are luminous at night, emitting from some part of their bodies a gleaming light, supposed to be phosphorescent and in some species of exceeding brilliancy.

In our country the glowworm, the wingless female of a beetle, Lampyris noctiluca, is well known; and in the southern parts of our island may be seen at night during the months of July and August, gemming the mossy couches with brilliant stars. The light proceeds from the abdomen; but though by far the most intense in the female, it is not altogether absent in the male, or even in the larvæ. The end to be answered by this phosphorescence is not very clear. Fig. 3685 represents the winged male and wingless females of Lampyris. Fig. 3686, the head of the male glowworm.

Mr. Rennie (in 'Journ. Roy. Inst.,' Oct., 1830) describes a singular caudal instrument in the larva of the glowworm, capable of being protruded at pleasure, in the form of a brush of filaments, or soft rays, themselves individually retractile or extensible, by means of which it clears its body from various extraneous particles. He observed the larva to bend back its tail, and suck up into a sort of funnel-shaped cavity, formed by the converging rays, particles of dust, or other impurities, till the cavity could hold no more; then, by a sort of vermicular movement of the rays, the accumulated matter was rejected, so as to be out of the insect's way. He also assures us that snails constitute the food of the larva of the glowworm, and that after the repast it cleanses itself from slime by means of its caudal apparatus. Fig. 3687 shows a magnified view of the cleansing instrument, opened and closed. Fig. 3688 the larva of the glowworm using its cleansing instrument. Fig. 3688* the larva of the glowworm devouring a snail.

In France a distinct species, Lampyris splendidula, is common. In Italy a beautiful fire-fly, Pygolampis Italica, of which both the male and the female are winged, is still more brilliant; in some parts it is very abundant, and when numbers are seen flitting at night among the groves, the effect produced is extremely beautiful.

The thick antennæ of the Paussus sphærocerus are luminous; and in the eyes of some moths, as the Cossus ligniperda, the same property has been noticed. It is, however, in the warmer regions of South America, and in the West India Islands, where the most brilliant of these luminous insects exist—radiant lamps of night—

> "Now motionless and dark, eluding search,
> Self-shrouded, and anon starring the sky."

Most have heard of the fire-fly of the West Indies. It is a species of beetle, Elater noctilucus, about an inch in length. It gives out its principal light from two transparent eye-like tubercles on the thorax, and there are also other luminous spots concealed under the elytra when closed, but apparent while the insect is on the wing, at which time it appears adorned with four brilliant gems of rich golden radiance. A paler light also shines out between the abdominal segments.

The Caribs of Domingo, a race whose memory is now passing away, were formerly accustomed to use these living lamps, during their evening household occupations. In travelling at night they fastened them to their feet, and in fishing or hunting during darkness required no other flambeau. The fondness of these fire-flies for gnats, which they greedily devour, led to their encouragement in houses and rooms, for the sake of a service of no little importance.

Southey, in his poem of 'Madoc,' has introduced this insect as furnishing the lamp by the light of which Coatel rescued the British hero from the hands of the Mexican priests:—

> "She beckon'd and descended, and drew out
> From underneath her vest a cage, or net
> It rather might be called, so fine the twigs
> Which knit it—where confined two fire-flies gave
> Their lustre. By that light did Madoc first
> Behold the features of his lovely guide."

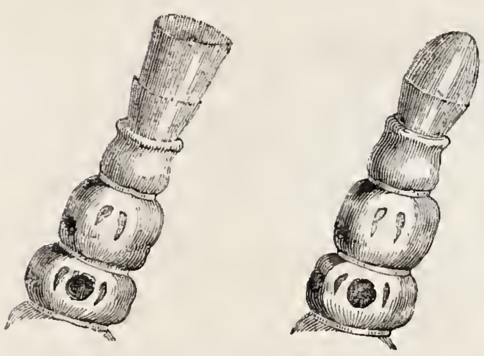
This species, as well as the Elater ignitus, and others, are common in the intertropical latitudes of South America, as well as in the islands. Fig. 3689 represents the Elater noctilucus.

If the accounts of some writers are to be accredited, the Elater noctilucus must yield the palm of brilliancy to an insect of the homopterous group or order, the Fulgora laternaria, or lantern-fly. It is a native of South America, about two inches and a half long, and about five inches in the expanse of its wings, having a hollow transparent projection from the head, seven or eight lines long, which is the organ whence the effulgence is said to issue. Madame Merian states that the first discovery which she made respecting the luminosity of these insects, caused her no small alarm. The Indians had brought her several, which in daylight exhibited no extraordinary appearance. She put them into a box until she should have an opportunity of drawing them, and placed it on a table in her apartment. In the middle of the night the confined insects made such a noise as to awake her, and she opened the box, which, to her great astonishment, seemed in a blaze; letting it fall in her fright, she was not less surprised to see each of the insects glowing as if on fire. According to her story, the light of a single insect is sufficient to read by. Unfortunately for Madame Merian her veracity is very questionable. Recent naturalists who have travelled in South America, and are well acquainted with this insect, assert the whole account to be completely fabulous. Sieber, a practised entomologist, took numbers of Fulgoræ during his stay in the Brazils, where he resided for several years, and treats Madame Merian's story as unworthy of notice.* We ourselves have been positively assured, by observers of

* Dr. Hancock, Dr. Burmeister, Prince Maximilian of Neuwied, deny the luminosity of this insect. They had abundant opportunities of seeing it in its native regions.

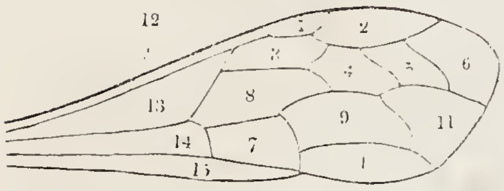
3699.—Butterfly-Plant.

3695.—Opion luteum.



3687.—Cleansing Instrument of Glowworm.

3686.—Head of Male Glowworm.

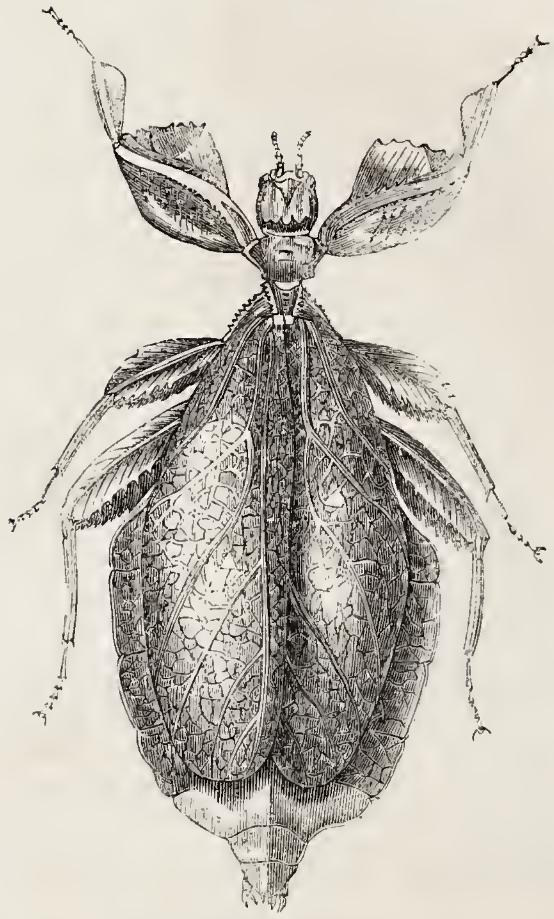


3692.

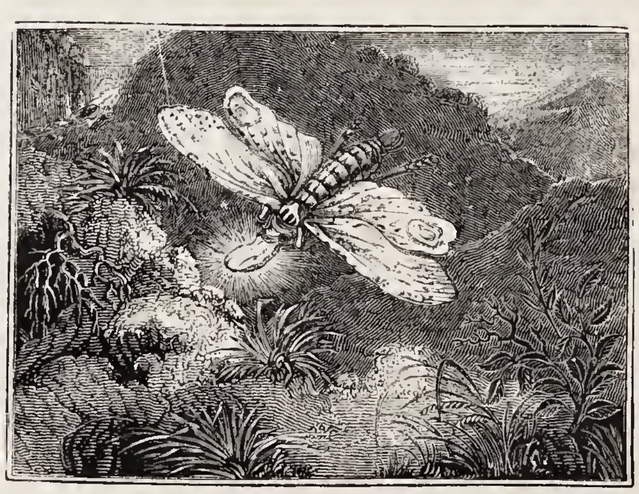
3692, 3693.—Wings of Hymenopterous Insect.

3691.—Lantern-Fly.

3688*.—Glowworm devouring a Snail.

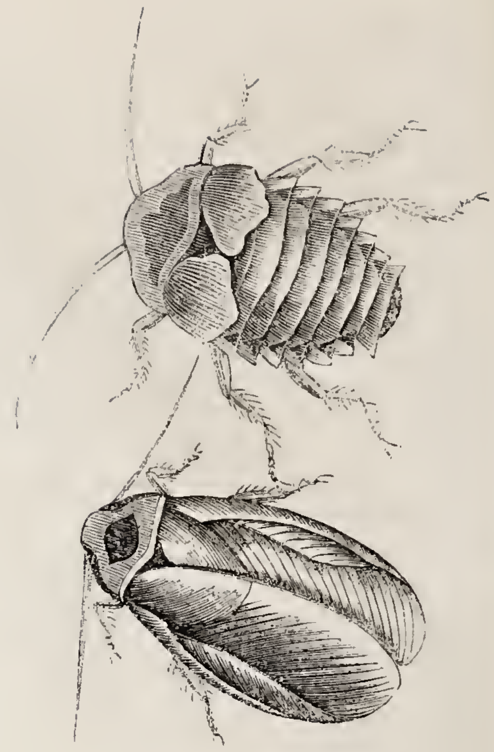


3698.—Leaf-Insect.

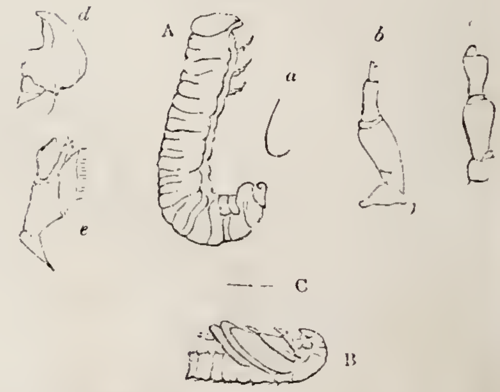


3690.—Lantern-Fly.

3688.—Glowworm using cleansing Instrument.

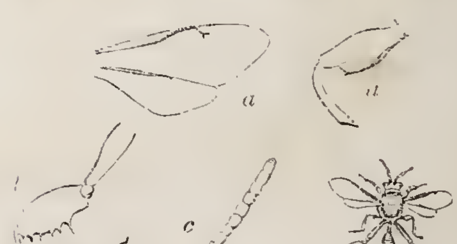


3697.—Giant Cockroach.

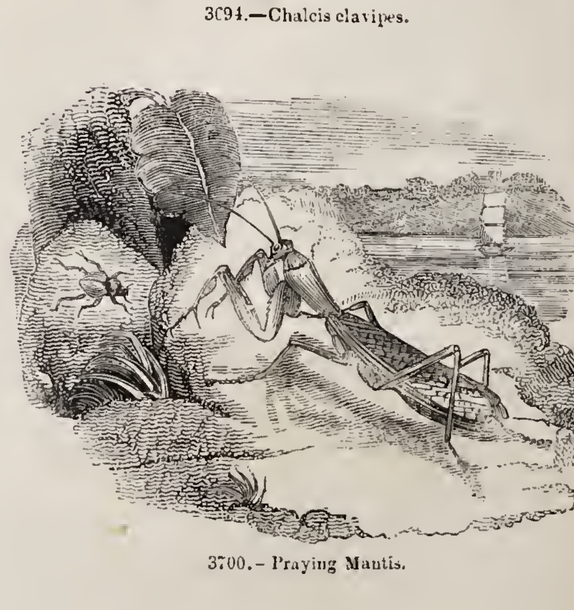


3696.—Larva of Coleopterous Insect.

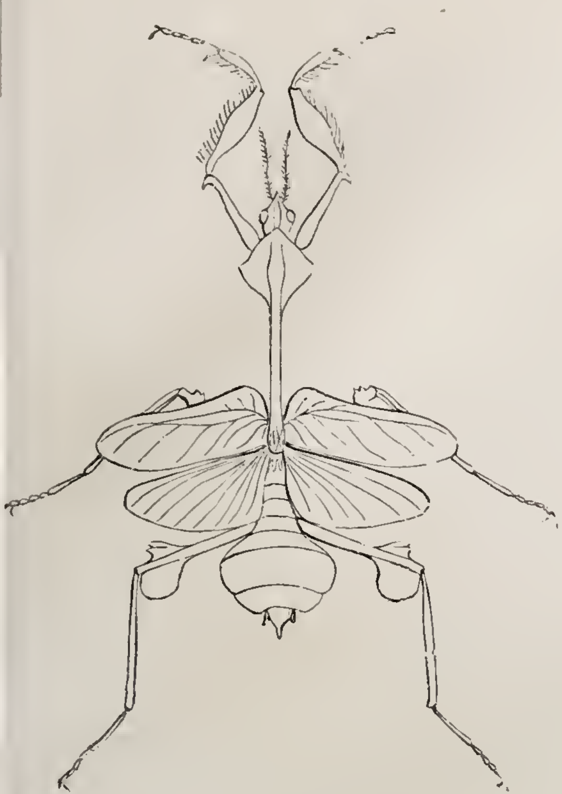
3689.—Fire-Fly.



3694.—Chalcis clavipes.



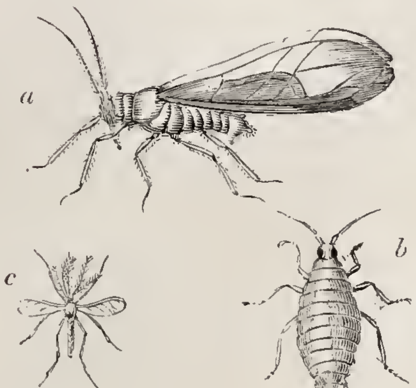
3700.—Praying Mantis.



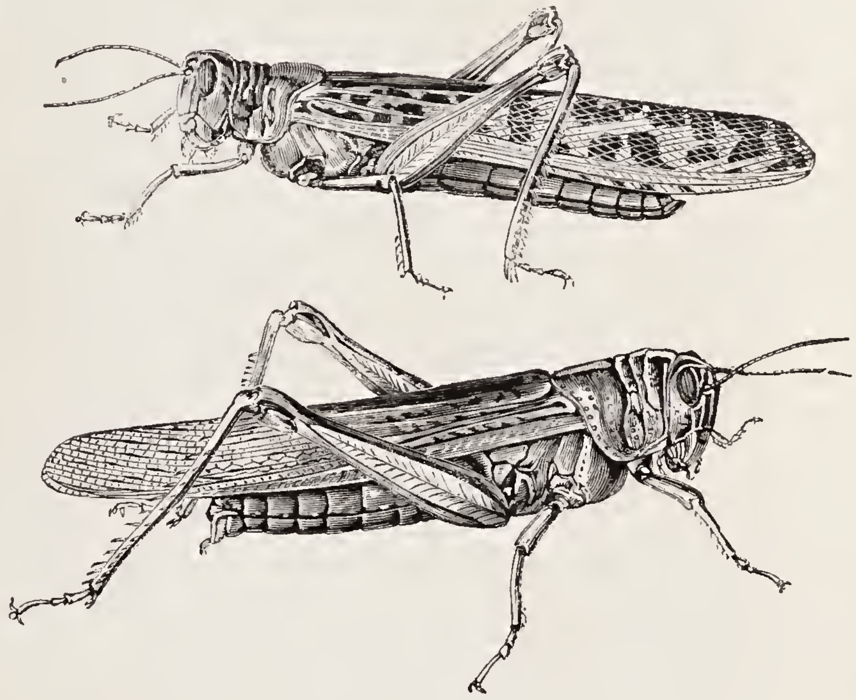
3701.—Mantis gougylodes.

3705.—Proboscis of Insect.

3704.—Virgin Dragon-fly.

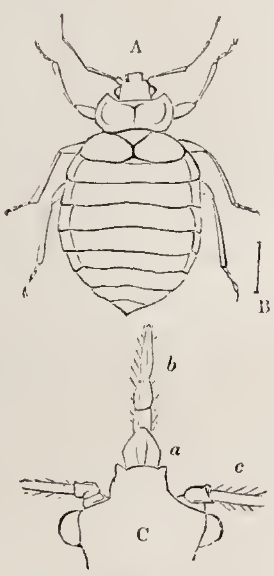


3709.—Aphis of Elm, of Willow, and Gnat.



3702.—Locusts.

3710.—Trembley's Breeding-Apparatus.

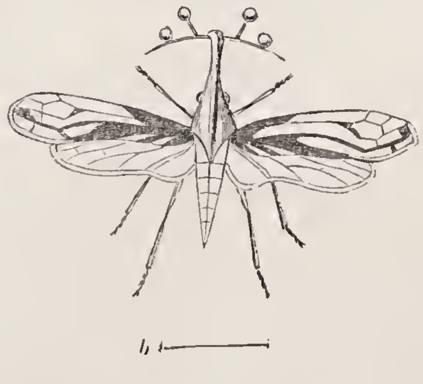


3706.—Cimex lectularius.

3711.—Réaumur's Breeding-Apparatus.

3707.—Helmeted Bocydium.

3712.—Butterfly and Moth.



3708.—Bell-bearing Bocydium.

3703.—Locust.

the highest scientific acquirements, that the assertions of Sieber as to the non-luminosity of the Fulgoræ are correct, and they have told us that the Indians regard the story as originating in the mistake of the White men, who, seeing the luminous Elaters glancing about like meteors, have in some unaccountable manner attributed their light to the Fulgoræ, perhaps because they could conceive of no other use for the hollow projection of its head than that of a lantern.

The Fulgora, in shrillness of voice and general manners, resembles its allies the Cicadæ; several species besides the F. laternaria are natives of South America, and many are natives of China, India, Manilla, Java, Malacca, and Africa (Westwood on the Family Fulgoridæ, in 'Linn. Trans.' vol. xviii. part ii. p. 133). Figs. 3690 and 3691 represent the Fulgora laternaria.

It is now time that we advert to a subject which we have hitherto avoided, viz. the classification of insects, having thought it best to defer any remarks until we had made our general observations upon the class at large, as far as our limits would permit; nor shall we now enter into the various arrangements proposed by different entomologists, from Linnæus to those of the present day. That, indeed, of Linnæus is known to most; his orders are seven, viz. Coleoptera, Hemiptera, Lepidoptera, Neuroptera, Hymenoptera, Diptera, and Aptera.

In this arrangement the characters of the wings only have been consulted; and, on the other hand, Fabricius instituted an arrangement on the variations of the parts of the mouth, in which he divides insects into thirteen orders. Mr. Waterhouse, in the 'Penny Cyclopædia,' gives the following system, observing that it appears to him the best to express the mutual affinities, and the grade of perfection of the primary groups into which the present class seem naturally resolvable: viz. 1, Hymenoptera; 2, Coleoptera; 3, Orthoptera; 4, Neuroptera; 5, Hemiptera; 6, Homoptera; 7, Lepidoptera; 8, Diptera.

HYMENOPTERA.—Hymenopterous insects possess four wings, of a membranous character, of which the anterior pair are the largest: they have all the parts of the mouth well developed: the females are provided with an ovipositor, in many so organised as to serve for a weapon of defence; in bees and wasps it is known as the sting. These insects undergo a complete metamorphosis; the larvæ are generally destitute of legs, and the pupæ have no power of locomotion. The neuration of the wings in the perfect insect is very simple, the nervures dividing them into few cells or intervening spaces, and they so nearly resemble each other in allied forms that the absence of some nervures or a difference in the outline of the cells has afforded good characters for the definition of groups. The wings of an hymenopterous insect, from Mr. Shuckard's work on 'Fossorial Hymenoptera,' are represented at Figs. 3692 and 3693. Fig. 3692, anterior wing, showing the cells: 1, stigma; 2, radial or marginal cell; 3, first cubital cell; 4, second cubital cell; 5, third cubital cell; 6, fourth cubital cell; 7, first discoidal cell; 8, second discoidal cell; 9, third discoidal cell; 10, first apical cell; 11, second apical cell; 12, costal cell; 13, externo-medial cell; 14, interno-medial cell; 15, anal cell. Fig. 3693, anterior wing, showing the nervures: *a*, costal nervure; *b*, post-costal nervure; *c*, externo-medial nervure; *d*, anal nervure; *e*, posterior margin; *f*, apical margin; *g*, radial; *h*, *h*, *h*, transverso-cubital; *i*, *i*, recurrent; *j*, transverso-medial; *k*, discoidal; *l*, subdiscoidal.

To the hymenopterous order belong the Ichneumon-flies—bees, wasps, ants, and their allies.

Fig. 3694 presents us with an example in Chalcis clavipes, one of the family Chalcididæ. This insect is found on shrubs in marshy situations; it is remarkable for the form of the hinder limbs, which, as in some beetles (Donacia, for instance) have the femur thickened and the tibia curved to serve as clinging organs. Referring to Fig. 3694, *a* shows the wings of Chalcis; *b*, the hind-leg; and *c*, the antennæ, magnified; *d* is the femur and tibia of Donacia. Of the Chalcididæ there are about 1500 distinct species natives of England. Fig. 3695 is a species of Ichneumon (Ophion luteum).

COLEOPTERA.—Coleopterous insects have mandibulate jaws and four wings, of which the anterior pair are modified into elytra, or hard, horny, or parchment-like covers for the posterior membranous wings, which are the true organs of flight. The elytra form by their union, when closed, a longitudinal suture. The larvæ are generally composed of thirteen segments, including the head (twelve excluding it): the body is soft and fleshy; the mouth exhibits nearly the same parts as in the perfect insect; there are three pairs of limbs, and sometimes there are also pro-legs. In this order are the beetles, divided into numerous tribes and families.

Fig. 3696 represents—A, the larva of a coleopterous insect; *a*, natural size; *b*, leg; *c*, antenna; *d*, mandible; *e*, maxilla: B, pupa; C, natural size.

ORTHOPTERA.—In the order Orthoptera the wings are four; the superior semi-coriaceous, with numerous nervures in a longitudinal direction, and finely reticulated. The anterior portion of the inferior wings is generally of a different substance from the posterior portion; the nervures are often more crowded, and in texture and appearance it more nearly resembles the anterior wings; the posterior portion is delicate and transparent, and when not in use, folded like a fan. The anterior wings often overlap when at rest, as in the cockroaches; but in some, as the locust, they meet at an angle, like the roof of a house. The limbs are diversely modified, in some for running, in others for leaping. The mouth is mandibulate, and well developed; metamorphosis incomplete (ametabolous). In the active pupæ the wings are rudimentary; in some instances the adults are wingless, and it is then difficult to distinguish the perfect insect from the pupa or larva.

To the order Orthoptera belongs the earwig (Forficula), the cockroach (Blatta), the mantis and Phasma tribes; the crickets, or Grillidæ; the locusts, or Locustidæ; and the grasshoppers (Acridiidæ).

As examples of this order, Fig. 3697 represents the giant cockroach (Blatta gigantea), reduced in size. This is a foreign species, notorious for its voracity; it will attack the extremities of the dead and dying. Fig. 3698 represents one of the Phasma or spectre tribe, Phyllia foliata, or leaf-insect. This extraordinary insect, one of a large family, is so leaf-like in all its parts, that were numbers clinging to a bush or tree, the eye would not easily distinguish them. The wings, in colour, texture, and the arrangement of the nervures, are completely foliaceous, and even the limbs look like twigs bearing smaller leaves or unfolding buds. It is a native of the hotter regions of South America. If some insects resemble plants, some plants, on the contrary, resemble insects; and if the Phasma tribe are imitations of foliage, the Oncidium papilio, or butterfly-plant, Fig. 3699, found in Trinidad, one of the Orchidaceæ, might well be mistaken for an insect; indeed it is very Phasma-like in its appearance. Fig. 3700 represents the praying mantis (Mantis religiosa), of carnivorous habits, and very leaf-like in appearance. "The names religiosa, precaria, sancta, &c. have been applied to various species on account of a peculiarity in their habits, that of erecting the thorax at an angle with the body, and placing together the large fore-legs like the hands of a person when at prayer; in this position they will remain perfectly motionless for hours." Their food consists of flies and other insects, which they watch for in the attitude described, and catch with great dexterity by means of their fore-legs; the prey is held by the fore-leg, the tibia being bent against the femur so as to retain the captive in the grasp. The opposing surfaces of these parts are covered with spines, which increase the tenacity of their hold. These insects are extremely ferocious, and when placed together will attack and devour each other, and fight with fury, till the weaker or less skilful falls a prey to the conqueror. They strike and parry with the edge of their fore-claws, the combat resembling that between two sabreurs. In China, the children, as we are told by Barrow, take advantage of the ferocious disposition of these insects, and put them together in bamboo cages, for the purpose of witnessing the barbarous conflict.

The female glues her eggs upon plants, arranging them symmetrically. The ametabolous larvæ are as savage as their parents, and will, in like manner, tear each other to pieces, the victors feasting upon the vanquished. The Mantis religiosa is common in Turkey, Greece, and southern Europe. From its attitude it is regarded with great respect by the Turks, who suppose it engaged in devotions.

Fig. 3701 represents the Mantis gongylodes, a native of India. Its habits are the same as the rest of its tribe.

Figs. 3702 and 3703 represent the locust, of which there are several species, celebrated for their ravages, and for their migratroy movements in numbers beyond calculation.

We need not here repeat the often quoted accounts detailed by various travellers in the East, and in different parts of Africa, respecting the clouds of these insects, often so dense and extensive as to obscure the sun, nor of the devastations they commit, devouring every thing where they alight, and often penetrating into the inmost recesses of houses, where every article of vegetable food soon vanishes before them. The poetical description in *Joel* (ii. 2-10) well describes their habits, their noise, the desolate wilderness they leave behind them, their voracity, and their invasion of cities and houses. Dr. Shaw, who has detailed the ravages of the swarms he saw in Barbary, observes, that they first appeared about the end of March, and increased into vast numbers in April, but returned into the extensive plains in May to deposit their eggs, and that the larvæ made their appearance in June, and were formed into compact bodies, each brood covering a square furlong of ground:—they marched onward in a phalanx, surmounting every obstacle in their way, entering houses and chambers, and desolating the gardens, undeterred by the slaughter made amongst the foremost. In this manner horde succeeded horde for days together. In about the course of a month they arrived at their full growth, and cast their pupa or nympha case, and as soon as the wings were dry and expanded, mounted into the air.

Morier, who made several observations on the locust at Smyrna, in 1800, describes the larvæ (of a dark colour) as first appearing in the middle of April, and blackening the fields—as being in the nympha state in May—and assuming their perfect condition in June. In July and August they deposit their eggs, which are hatched the succeeding spring.*

Vast clouds of locusts are often seen in Tartary (L. Tartarica?), and have at different times invaded Poland and Russia. In Spain and Italy the North African locust has not unfrequently committed extensive ravages. Barrow narrates his observation on the swarms he witnessed in South Africa, 1797, where the whole surface of the district he visited for an area of two thousand miles was literally covered by them.

These insects, both in their larva state, their nympha state, and perfect condition, are alike the scourge of the countries in which they are found, and have been so, especially in the East, time immemorial. In 1799 the whole of the country from Mogador to Tangier, extending from the sea to the confines of the Sahara, was covered and desolated by them; a violent hurricane at last swept the country, and drove them into the sea, whence they were again cast ashore, and the putrid exhalations of their dead bodies combined with the famine to produce a dreadful plague.

Locusts are eaten in many places—they are mentioned as among the clean meats in *Leviticus* xi. 22. In the plain of Bushire they are collected, dried, and salted, and sold to the peasantry: when boiled the yellow ones turn red, and eat like stale shrimps. The Arabs grind them into powder, which they make into small round cakes, which serve when bread is scarce. The same mode is practised in Senegal. In the Mahratta country the common people salt and eat them. They are eaten by the Hottentots; and formed anciently part of the diet of the Ethiopians and the Parthians.

NEUROPTERA.—The insects composing this order have four naked transparent wings, minutely and beautifully reticulated like fine gauze. The mouth is usually fitted for mastication; the larvæ have six legs; their metamorphosis is variable, but usually semi-complete. The may-fly and dragon-fly are familiar examples. Fig. 3704 represents the virgin dragon-fly (Calepteryx virgo), a beautiful species, with a rich blue body and scarlet wings. Of the habits of these insects we have already given some details.

HEMIPTERA.—The Hemiptera have a suctorial mouth, and undergo an imperfect metamorphosis. The elytra are coriaceous, softer at the extremity, and folding one over the other when at rest; the beak is attached to the fore-part of the head, which is small and seated on the same plane as the thorax; the body is often flat, or even slightly concave above. The rostrum, or proboscis (Fig. 3705), when not in use, is suddenly curved backwards, and lies close to the under surface of the thorax. It consists of a jointed process, *a*, grooved upon the upper side, and in this groove are four setæ, or bristles, *b*, which are covered at their base by another appendage, *c*, regarded as analogous to the upper lip, or labrum. In the figure the setæ are seen disengaged from their sheath, and the labrum is drawn a little forwards, and forms, as it were, the lip of the snout; *d*, the base of one of the antennæ.

There are a few wingless species.

The insects under this order are the water-scorpions (Nepa), the water-boatman (Notonecta), the bug tribe (Cimicidæ), most of which are winged; but one, the Cimex lectularius, is wingless: it is a disgusting pest of the bed-room. This species is represented magnified at Fig. 3706. A, the insect; B, its natural length; C, the head; *a*, the labrum; *b*, the proboscis; *c*, the base of the antennæ. This insect was not known in England previous to the Great Fire of London, 1666, but was common on the Continent long before that time. What may be its original country it is impossible now to determine. It is one of the blood-sucking insects; but hundreds and thousands live in empty houses, under the paper of walls, in chinks and crannies, without the means of dipping their proboscis into the skin of any person, and the query is, how do they exist?

To this order belong the Reduviidæ, the water-measures (Hydrometridæ), the Coreidæ, and other families.

HOMOPTERA.—The Homoptera forms only a sec-

* There is some discordance between Dr. Shaw's and Morier's statements; but probably locality and temperature regulate the appearance of the perfect insect, the desposition of the eggs, and their time of hatching.

tion of the Hemiptera in Latreille's system; but Leach, Stephens, and others, regard it as an order.

The homopterous insects have the rostrum arising out of the lower part of the head near the chest. The elytra are almost always tectiform and semi-membranous; sometimes resembling the true or under wings; the head is large and broad; the antennæ are minute; the larvæ are ametabolous; the perfect are furnished with an ovipositor. The Homoptera feed on vegetable juices.

To this order belong the Cicadæ, or tree-hoppers; the Fulgoridæ, of which Fulgora laternaria is an example; the Cercopidæ, or Cicadellæ of Leach; the Thripidæ, the Aphidæ, and the Coccidæ, or gall insects.

Of the Cercopidæ, we select for illustration two species of the genus Bocydium:—Fig. 3707, Bocydium galeritum; Fig. 3708, Bocydium tintinnabuliferum.

The Bocydium galeritum, so called from its strange helmet, is a native of Brazil. The disc of the thorax is elevated into a singular process, first rising and then arching backwards, and broad at its base and middle, whence it narrows to a point; the wings are transparent.

The Bocydium tintinnabuliferum, or bell-bearer, is even more grotesque; its thorax is black and glossy, the posterior part is elongated, and from the disc arises a vertical appendage, at the top of which is a slender transverse stem, bearing four pedunculated little balls of a black colour, and covered with fine hairs. It is a native of Brazil.

Of the Aphidæ we have already spoken. Fig. 3709 represents—*a*, the aphis of the elm, winged; *b*, the aphis of the willow, unwinged. These are contrasted with a dipterous insect, the common gnat, *c*, with which some popular writers have confounded them. In the aphides the upper wings, or elytra, completely resemble in texture the under wings, and when closed form two sides of an angle, like the high-ridged roof of a house. Many, however, are wingless.

Trembley, Réaumur, Bonnet, Bazin, and others, have conducted a series of experiments on these insects with reference to their productive powers, which, indeed, are most wonderful, and such as without sufficient testimony we should hesitate to believe.

Bonnet selected a young aphis from the instant of its birth, and placed it upon the leafy branch of a spindle-tree (Euonymus), which he had most carefully and minutely examined to assure himself that no other individual was upon it. Having fixed the branch in a phial of water, he set it in a garden pot of mould, and covered the whole with a glass vessel, the edges of which he buried in the mould. Not Danäe, in her tower of brass, was so effectually secured. This was done on the 20th of May, and day after day, hour by hour, from five in the morning till nine or ten at night, he continued to watch the imprisoned insect with a magnifying-glass. He found that it changed its skin four times, and grew like a caterpillar; and on the 1st of June it produced a living young one, and continued to produce to the 22nd of the same month inclusive, giving birth to ninety-five, all alive, and without ever having paired.

M. Bazin, who selected the aphis papaveris, and the aphis rosæ, for similar experiments, witnessed the same results.

Trembley selected the aphis Sambuci—one young aphis immediately after birth: he placed it on a slip of elder, and enclosing it in a glass tube, open at both ends, plunged one end into water, and stopped the other with cotton. The other he treated in nearly the same way. This took place on the 28th of September: one on the 25th of November, the other on the 28th, began to produce young, and continued at intervals, according to the temperature of the atmosphere.

Lyonnet and Réaumur verified by experiments the observations of Bonnet and Bazin.

Not content with his previous experiments, and desirous to push them still further, Bonnet commenced a fresh series of the most careful observations, and demonstrated that at least five generations of the aphis Sambuci may succeed each other, the females never pairing; and, indeed, had not he failed in procuring fresh elder branches, as the winter set in, he might have continued his operations with further results of the same kind; indeed, with the aphis of the oak, he succeeded as far as the ninth generation. Lyonnet conducted similar experiments, with the same results. In all these instances living young were produced; but it would appear that after pairing the aphides produced eggs, or rather a kind of pupa enclosed in a sort of capsule. Fig. 3710 shows Trembley's mode of conducting his experiments, and Fig. 3711 that of Réaumur.

LEPIDOPTERA.—The order Lepidoptera contains those beautiful insects known as butterflies and moths; insects with a spiral tubular proboscis for extracting the nectar of flowers, and four plumed or scaly wings. Latreille divides the Lepidoptera into three great sections, viz., Diurna, Crepuscularia, and Nocturna.

The Diurna is composed of the butterflies, insects which fly by day, and on which the antennæ are terminated by a knob or thickening. The anterior margin of the posterior wings is simple, and the wings are usually erect in a state of repose.

The Crepuscularia are distinguished by being gradually thicker from the base towards the extremity, and forming a prismatic or fusiform club; the extreme tip is slender, pointed, and often recurved; the wings, when at rest, are horizontal, or slightly inclined: the posterior wings have a rigid spine at the anterior margin, which is received into a hook on the under surface of the superior wings. These insects are the sphinx-moths; they generally fly in the morning, evening, and afternoon.

The Nocturna have the antennæ setaceous, diminishing from the base to the point, and often plumed, serrated, or pectinated, especially in the males. The wings, during repose, are either horizontal or deflexed; and, as in the Crepuscularia, the under wings have a spine on their anterior margin, which hooks into a corresponding groove of the upper wings. In some few species the females are wingless; the larvæ differ greatly in form. These insects are the true moths, which fly at night, after sunset, though to this rule there are exceptions.

As examples of the butterfly and moth, Fig. 3712 represents—*a*, the marsh fritillary butterfly (Melitæa artemis), and *b*, the six-spot Burnet moth (Anthrocera filipendula). Of the British Lepidoptera we have several pictorial groups, illustrative of the general characters of these beautiful insects.

Fig. 3713 represents the following species:—*a*, the orange-tip butterfly (Pontia Cardamines); *b*, the black-veined white or hawthorn butterfly (Pieris Cratægi); *c*, the small white butterfly (Pontia Rapæ); *d*, the green-veined white butterfly (Pontia Napi); *e*, the common cabbage butterfly (Pontia Brassicæ); *f*, the brimstone butterfly (Gonopteryx Rhamni); *g*, the pale-clouded yellow butterfly (Colias Hyale).

The orange-tip butterfly is tolerably common in our island, frequenting the borders of woods and lanes winding through a woodland but cultivated district. It usually appears about the end of May; seldom in April. The sexes are very dissimilar.

The small white butterfly bears, excepting in size, a close resemblance to the common cabbage species, from which, however, it is very distinct, as is proved by their respective caterpillars. It is very common and is one of the pests of the garden, laying its eggs on cabbages, cauliflowers, &c.

The green-veined white butterfly is also extremely common, appearing first in May, and also in July. It frequents gardens, laying its eggs on cabbages and other culinary vegetables.

The common cabbage butterfly is well known, as is also its caterpillar, the ravages of which in the kitchen-garden are most annoying.

The brimstone butterfly is one of the earliest that make their appearance, and may be seen on the wing flitting along the lanes and copses in the month of March, when a bright sunny morning gives hope of the "year confirmed." As the spring advances, it becomes more common, and a second flight comes forth in August.

The male is of a pure sulphur-yellow above, and in both sexes a small spot of orange occupies the centre of each wing. The female is greenish yellow above; the under side is paler than the upper.

The pale-clouded yellow butterfly is rare, and found chiefly on the sea-coast in the counties of Kent, Sussex, and Suffolk. A pale variety occurs in the vicinity of Dover. Seldom has it been found far from the sea. It is a fine species: the male is usually of a rich sulphur-yellow, the female nearly white: the upper wings are marked near the middle with a black spot, and at their extremity have a deep black border, almost divided by a series of yellow spots into two. The under wings have a large orange spot in the centre: beneath, the upper wings are whitish yellow, orange-stained at the tip, with a black ring-spot enclosing a yellow centre near the middle, and with a row of small dusky marks at some distance from the outer margin. The lower wings beneath are dull orange with a large and a small silvery spot in the centre surrounded with rust-red, and a curved row of small black spots. Fringe of the wing roseate.

Fig. 3714 represents—*a*, the clouded yellow butterfly, Colias Edusa (male), contrasted with the pale-clouded butterfly (female), Colias Hyale.

Fig. 3715 represents—1, the swallow-tail butterfly (Papilio Machaon); 2, the purple emperor, or highflyer (Apatura Iris); 3, the orange Argus or wall butterfly (Hipparchia Megæra); 4, the great tortoiseshell butterfly (Vanessa Polychloros); 5, the small tortoiseshell butterfly (Vanessa Urticæ); 6, the red admiral (Vanessa Atalanta); 7, the peacock's eye (Vanessa Io).

The swallow-tail butterfly (Papilio Machaon), though by no means so rare as its ally the P. Podalirius, which indeed can scarcely be called a British butterfly, is yet by no means generally abundant. It has never been observed in Scotland, and seldom in the northern English counties. On the Continent it is not unfrequent, and is abundant in Syria and Egypt, as well as in several parts of France, Italy, &c. It does not appear on the wing in our island till the beginning of June.

Of all our indigenous butterflies this is the largest; the female, which, as usual, exceeds the male in size, not unfrequently measuring three inches and a half in expanse of wings. Its flight is powerful. The general colour of the wings is black, powdered with yellow, and relieved by bold yellow markings, which colour indeed is spread over the basal half of the hinder wings. From the posterior margin of these projects an acute slip, which may be compared to the outer tail-feathers of the swallow, and at each inner corner is an ocellated spot of red, with an anterior crescent of light blue; the whole nearly surrounded by a ring of black.

The purple emperor, or highflyer (Apatura Iris).

It is only in the oak-woods of the more southern counties of our island that this splendid butterfly appears, and that not in abundance; it has been styled "the purple emperor of the British oak;" and if beauty, strength of wing, fearlessness, and a lofty, bold, and vigorous flight entitle it to pre-eminence, it certainly stands at the head of our native butterflies. It seldom makes its appearance before the month of July, and may then be seen during the middle of the day, while the sun glows with meridian effulgence, soaring on rapid wings high over the summits of the tallest oaks, on the topmost twigs of which it settles for repose towards the approach of evening.

The wings of this species are firm in texture; their general colour above is dark brown, changing in certain lights into rich purplish blue of metallic lustre, and relieved by marks of white. On the hinder wings near the inner angle is a small black spot surrounded by red; under surface of wings rust-brown, varied with white and black; an ocellated spot on both. The caterpillar is pale green, with horns reddish at the tip. It feeds on the oak, willow, and ash.

The orange Argus, or wall butterfly (Hipparchia Megæra).

This butterfly is by no means uncommon, and is very generally spread, appearing from May to August; it flits lightly and rapidly from one resting-place to another, expanding its wings to the sun.

The fore-wings are orange-yellow, inclining to brown, marbled and banded along the edges with dark brown. Near the outer angle an ocellated spot of white with a black ring. Hinder wings with a row of spots, from three to five in number, in a crescentic line near the outer margin; the edge banded with brown. The caterpillar is hairy, of a light green, a whitish line running along each side.

The great tortoiseshell butterfly (Vanessa polychloros).

It is principally in the southern counties of our island that this butterfly makes its appearance, and usually about the middle of July. On the Continent it is common, more particularly in the more southern districts. It is rapid on the wing, and often settles on dry pathways and the trunks of trees, delighting in the fervent rays of the sun. The wings are angulated, and often measure upwards of two inches and a half in extent; their colour above is dark orange-red, with a narrow vandyked edging of blue, and a second of black; the fore-wings are marked anteriorly with abbreviated bands of black, and spots of the same colour about the centre; the hinder wings have a large spot of black near the middle of the anterior margin.

The caterpillar of this species is gregarious, spiny, and of a brownish tint, with a lateral stripe of orange; the spines are slightly branched and yellowish. Collected in groups, the caterpillars weave webs, while very young, in the branches of various trees, as the willow, elm, and cherry, for their protection, but disperse after they have once or twice changed their skin.

The great tortoiseshell butterfly is closely related to the small tortoiseshell (V. Urticæ), one of the most common of our British species, and of which the caterpillar, of a blackish colour, with yellow stripes, is found in abundance on the nettle.

The small tortoiseshell butterfly (Vanessa Urticæ), abundant not only in England, but on the adjoining continent, is conspicuous for its beauty and the lightness with which it flits from flower to flower. Two broods occur every year—one early in spring, the other in autumn.

In Italy this butterfly continues on the wing during the winter, in fine weather; and in our

3713.—Group of Butterflies.

3714.—Clouded Butterflies.

3715.—Group of Butterflies.

3716.—Group of Butterflies.

3717.—Group of Hawk-Moths, Caterpillars, and Pupæ.

island numbers, as it would appear, pass that season in a torpid condition, issuing from their retreats in February or March, when the sun breaks forth cheerfully, soon perhaps to be beclouded. Hence the expression of Linnæus respecting this species—"fallax veris indicium" (a deceitful harbinger of spring).

The red admiral (Vanessa Atalanta). Beautiful is this butterfly, with its velvet-black wings broadly banded with red, and relieved by white and blue. In all parts of our island it is very common, as well as over Europe, and the districts of Africa bordering the Mediterranean.

The caterpillar of the red admiral (or admirable of some writers) is solitary, spinous, and greenish, with a lateral line of yellow spots. It feeds on the nettle.

The peacock's-eye (Vanessa Io). The colour of this well-known species is deep brownish red inclining to purple, with a large eye-like spot on each wing above: beneath (as in the figure) the wings are dark shining brown, traversed by fine undulating lines of black.

Fig. 3716 represents—1, the silver-washed fritillary (Argynnis Paphia); 2, the pearl-bordered likeness; 3, the silver-studded blue butterfly (Polyommatus Argus); 4, the small heath butterfly (Hipparchia Pamphilus); 5, the Glanville fritillary (Melitæa Cinxia); 6, the Duke of Burgundy fritillary (Nemeobius Lucina); 7, the common copper butterfly (Lycæna Phlœas).

The silver-washed fritillary (Argynnis Paphia). This beautiful butterfly, sometimes called the great fritillary, is generally spread over our island, appearing in June about the sides of woods, and flitting on rapid wings. The upper surface of the wings is of a bright orange-brown, with three rows of black marginal spots, and with several black marks near the centre. The caterpillar is solitary, feeding on the wild viola canina, the nettle, &c.: it is tawny, with a yellow dorsal line, and beset with hairy spires; two dark lines run along the sides.

The pearl-bordered likeness (Melitæa Athalia). This species, also termed the heath fritillary, is not uncommon in the more southern parts of England, and in Devonshire. It appears in June, and is found in the open glades of woods, and about heathy commons. It is subject to several variations of colouring, a circumstance which has led to some confusion of names. One variety is the Papilio pyronia of Hübner. The ordinary colouring is orange above, with undulatory lines of black. The caterpillar feeds on the plantain and also on the common heath. It is spiny, of a black colour, and spotted with white. To this species is referable the Papilio maturna of some authors.

The silver-studded blue butterfly (Polyommatus Argus), blue Argus. This elegant little butterfly is not uncommon in the midland and southern districts of England, flitting about in June, over clover fields and ground where the broom grows abundantly, on which herbs the caterpillar feeds. The male and female differ much in colouring, the former having the upper surface of the wings of a deep blue, passing into black round the hinder margin, and bounded by a fringe of white. The wings of the female above are of a dull brownish black, the anterior pair having a tawny margin.

The small heath butterfly (Hipparchia Pamphilus), golden heath-eye. This species is common throughout the whole of our island, frequenting short-grassed hills, upland pastures, and dry heathy grounds, and appearing in June; a second flight occurs in September.

The wings above are of a pale orange or ochre yellow, with a fringe of long white hairs; underneath, the fore-wings are clouded with ash-colour, and have near the tip an ocellated spot of black with a white centre. The hinder wings below are clouded with greenish brown and grey, with two or three indistinct ocellated spots.

The Glanville fritillary (Melitæa Cinxia).

On the adjacent continent this species is abundant, appearing in June; but in England it must be considered as of rare occurrence, though it is found in the Isle of Wight, on the hills about Dover, and along those of our southern coast. Its colour above is orange-red, marbled and spotted above with black and yellowish; a row of black points runs parallel with the posterior margin of the hinder wings. The colour of the wings is paler below than above.

The caterpillar is black, dotted with white, and with the head and pro-legs red; it is gregarious in its habits.

The Duke of Burgundy fritillary (Nemeobius Lucina), small fritillary.

This species is rare in our island, or rather, perhaps, local in its distribution, being chiefly confined to the south-eastern counties, appearing about the middle of May. The wings are dark-brown, the anterior pair having three transverse bars of irregular pale yellow spots, the marginal series being dotted in the centre with black. The hinder wings are almost similarly variegated.

The common copper butterfly (Lycæna Phlœas). In every part of our island, and on the adjacent continent, this pretty butterfly is tolerably abundant; it extends to Asia, and occurs also in North America. It is light, quick, and active in its movements; and makes its appearance in June, July, and August. The anterior wings, which are not indented at the edge, are of a rich copper colour, spotted with black, and broadly margined with the same. The hinder wings are brownish black, with a copper band posteriorly, spotted along the margin with black. Under surface of the wings paler. This species is subject to considerable variations of colour.

From the butterflies we may now pass to the sphinx or hawk moths, the Crepuscularia of Latreille, the Sphingidæ of most British entomologists.

Fig. 3717 represents—1, the death's-head hawk-moth (Acheronta tropos); 2, the eyed hawk-moth (Smerinthus ocellitus); 3, the privet hawk-moth (Sphinx Ligustri); 4, the poplar hawk-moth (Smerinthus Populi); 5, the hornet moth (Specia apiformis); 6, the humming-bird moth (Macroglossa Stellatarum); 7, the golden-tail hawk-moth (Trochilium cynipiforme). The hawk-moths are remarkable for their size, and the extent of their anterior or upper wings, which are extremely vigorous, and well adapted for rapid flight. Their progression through the air resembles that of a hawk, whence their appellation.

The caterpillar is naked, cylindrical, always with sixteen feet, and mostly with a dorsal horn or taper appendage near the extremity of the body; the sides of the body are almost invariably marked with oblique stripes. The remarkable attitude which the caterpillars of the hawk-moths often assume, resembling that of the fabulous sphinx of the ancients, suggested to Linnæus the scientific term (genus Sphinx, Linn.; family Sphingidæ, Auct.) by which they are still denominated. In order to undergo their transformation, and assume the pupa state, these caterpillars descend to the ground. The pupa is naked and conical, and often furnished with a detached horn extended beneath the breast, containing the spiral proboscis, which in some species is of extraordinary length. Some hawk-moths, however, have it short, and in the pupa of those species this horn is wanting. We may here observe, that there is an interesting connection between the length of the tongue, or spiral proboscis, and the rapidity of flight, which merits attention. Such species as have this organ of great length, hover over tubular flowers, extracting the honey from the deep nectary, which they are thus enabled to reach; and here again we are reminded of the humming-bird with its long suctorial tongue.

The caterpillars of some species are capable of elongating and contracting the three anterior segments of the body in a very curious manner, as we observe in the proboscis of the elephant. These caterpillars undergo their transformation in a cocoon within a folded leaf on the ground; the majority, however, descend to a considerable distance into the earth, and form an oval cell, where they assume the pupa state, to issue forth a perfect insect.

The death's-head hawk-moth, or bee tiger hawk-moth (Acheronta atropos), Sphinx atropos, Linn. This magnificent species appears to be distributed over our island, and Europe generally; its singularly marked thorax and the shrill sound it emits have rendered it an object of terror with the superstitious, and to the evil influence of these dreaded hawk-moths, which happened to make their appearance in great numbers in Brittany during the prevalence of an epidemic raging at the time with violence, the excessive mortality was popularly attributed.

This hawk-moth is a notorious despoiler of bee-hives; it not only robs the combs of the honey, but scatters the terrified bees in every direction. It is indeed very strange that, without sting or shield, and with no advantage except that of size and courage, this moth should be capable, singly and unassisted, of contending successfully with a horde of sting-armed insects, and driving them from their fortress.

The death's-head hawk-moth varies from four to five inches in the expanse of its wings. The upper pair are brown varied with black. The disc is marked with undulating lines of black and ferruginous patches, and powdered with white. Hind wings fulvous orange, with a narrow central and a broader indented bar running parallel with the hinder margin. Head and thorax brownish black, the latter with a large pale skull-like mark on the back.

The eyed hawk-moth (Smerinthus ocellatus), Sphinx ocellatus, Linn.

This beautiful species is widely distributed through England, but is rare in Scotland; on the Continent it is abundant. It makes its appearance in May; it varies in the expanse of its wings from two inches and three-quarters to three inches and three-quarters. The fore-wings are of a pale rosy ash, variegated with pale chocolate-brown and undulated marks of dusky. The hind wings are of a rose-pink, shaded off to grey on the margin, and marked near the inner angle with a large black spot, with a pale blue ocellus, the middle being of a slaty black.

The privet hawk-moth (Sphinx ligustri). This elegant moth is by no means uncommon, varying in the expansion of the wings from three inches and a half to nearly five inches. The fore-wings are of an ashy colour tinged with roseate, and shaded and marbled with dusky brown. The hind-wings are of a pale rose-colour, darker at the base, with three black bands; the sides of the thorax are ashy white, the back black. The caterpillar feeds on the privet, lilac, elder, ash, &c. The moth appears in June or July.

The poplar hawk-moth (Smerinthus populi), Sphinx populi, Linn. This species is very common, occurring in England and the south of Scotland. Its expansion of wings is often more than four inches. The upper wings are of a delicate lilac grey, with undulations of brown. The base of the hinder wings is broadly ferruginous. The body pale lilac grey. The males have the markings of the wings deeper than the females. The caterpillar is pale green, sprinkled with minute white tubercles: the spiracles and membranous feet are reddish; oblique lateral lines pale yellow. The food of the caterpillar consists of the leaves of the willow-poplar and aspen: the moth appears from the end of June to the middle of August, and sometimes as late as September.

The hornet-moth (Sphecia apiformis). This small but very beautiful moth is of a brownish black: the head and palpi are orange-coloured; the thorax has a large orange patch on each side in front, and two ochre patches on the disc behind. The abdomen is ringed with orange and black. The wings are narrowly edged with ochre-brown; but everywhere else transparent, like the wings of a wasp or hornet.

The caterpillar is thick and whitish, and feeds upon the wood of the trunks of willow and aspen trees, to which it often occasions great damage. The pupa is elongated and of a dark chestnut colour; this stage is assumed in April, and the perfect insect is produced at the end of June.

The humming-bird moth (Macroglossa stellatarum). Of this interesting species three broods appear every year, namely, in April, June, and September, and specimens have been taken as late as Christmas; indeed it is probable that some occasionally live through the winter. "This moth," says Mr. Curtis, "in the winged state frequents gardens, flying in the sunny weather between the hours of ten and twelve in the morning, and those of two and four in the afternoon. Its food is the nectareous juice of tube-bearing flowers. This it extracts with amazing address by the assistance of its exserted spiral tongue, inimitably poising itself all the while on rapidly vibrating wings, whence its name of humming-bird. It is delightful indeed to an entomological eye to behold and contemplate the dexterity exhibited by this charming insect whilst it sails, all gaiety and grace, round the tall sprig of a larkspur, or other flower, probing to the very bottom every single tube, neglecting none, and trying no one twice." Fortunately the species is by no means of rare occurrence in nearly every part of the kingdom, so that opportunities of observing it are not uncommon.

The expansion of the wings of this moth is nearly two inches; they are of a dusky brown colour, with waved transverse bars of black. The hinder wings are orange-coloured. The body is varied with yellow and black.

The caterpillar is dark green, with a dusky line down the back, and a white lateral longitudinal line. Legs yellow.

The golden-tail hawk-moth (Trochilium cynipiforme), Sphinx chrysorrhœa, Donov. This is a small species, and by no means common. It is of a blue-black colour; on the head is a white stripe, and the collar and palpi are yellow. The thorax has a yellow stripe on each side, and the breast a yellow spot; the abdomen has a yellow mark at the base, and three yellow bands, the last of which is double in the male. The wings, which are transparent, like those of a gall-fly, have the veins and margins brown, glossed with blue and fulvous, and a transverse, lunate, central spot of orange margined with black on the outside. Legs yellow.

The caterpillar is whitish, with a brown head, and is found under the bark of the oak and birch. The insect appears in June.

From the sphinxes, or hawk-moths, we pass to the true moths, remarkable for their full plumage and blended tones of colouring. To enter into analysis of the several families into which these insects are divided (and the same observation applies to the

butterflies), or to define the multitudinous genera, is not our present purpose; we aim merely at calling attention to some of the species likely to attract from their beauty and habits, and at the same time convey an idea of the extent of variation of form which obtains among them.

Fig. 3719 represents—1, the vapourer moth (Orgygia antiqua); 2, the pebble prominent (Notodonta ziczac); 3, the goat-moth (Cossus ligniperda); 4, the clouded buff moth (Euthemonia Russula); 5, the pink underwing (Callomorpha Jacobæa); 6, the double-o moth (Cymatophora Oo); 7, the orange underwing (Brepha Parthenias). The caterpillars and pupæ are referred to by the same figures as the perfect insects.

The vapourer moth (Orgygia antiqua), perfect insect, caterpillar, pupa, and wingless female. This species is very diurnal in its habits, and is far from uncommon in our island, and is, indeed, abundant in the neighbourhood of London, occurring even in the streets. Its flight is short, jerking, vacillating, and interrupted. It rests with its anterior wings extended, and its antennæ elevated. The wings are ferruginous; the anterior are clouded with brown, with two undulated and almost obsolete streaks, a pale crescent-shaped spot on the disc, and a snow-white sublunate spot at the lower angle; the hinder wings are unspotted. The female is of a dark cinereous tint, destitute of wings, and with the antennæ serrated. This is often seen surrounded by crowds of suitors.

The pebble prominent (Notodonta ziczac), perfect insect, caterpillar, and pupa. The pebble prominent is by no means one of our common moths, nor is it very generally distributed. In the male the anterior wings are pale chestnut, brown at the base, with two abbreviated streaks on the anterior margin, between which is a large subquadrate whitish patch, followed posteriorly by a larger ocelliform one, tinged with purplish, intersected by black dashes on the nervures, margined anteriorly by a deep brown lunule, and posteriorly by greyish clouds and a whitish streak; hinder margin with a narrow black line: posterior wings ash-coloured, with a central lunular dusky spot, and a narrow marginal line. The female has the anterior wings of a more uniform chestnut tinge, and the hinder wings mouse-coloured.

The perfect insect first appears in May; but from this month to July there is a gradual accession of individuals, though not in great numbers.

The goat-moth (Cossus ligniperda), perfect insect, caterpillar, and pupa. In many parts of our island this fine moth is by no means uncommon. It is found from June to the end of July, infesting oaks, willows, poplars, aspens, &c., upon the wood of which the caterpillar feeds, working its way through the solid substance of the tree, and consequently proving highly destructive, the more especially as it is three years before it assumes the pupa state.

The perfect insect measures from two inches ten lines to upwards of three inches, or in the female to three inches six or nine lines, in expanse of wings. The anterior pair are clouded with greyish and brown, with numerous transverse irregular black streaks and reticulations. The posterior wings are dusky, with obscure reticulated streaks towards the hinder margin. This moth is not very active, at least during the day, and may be observed reposing amidst the foliage of the trees, which it habitually frequents.

The caterpillar emits a most disgusting odour; it attains to a huge size, and is of a dull rufescent colour, with large shining red patches on the back, and two triangular black spots behind the head, which latter is black. It lives three years before its change into a pupa, which is generally in the autumn. The caterpillar searches for a convenient place, and then shrouds itself in a case composed of pieces of wood, which it unites together by means of a strong glutinous substance, lining the whole with silk. The pupa is brown, and strongly denticulated on the margin of each segment.

The clouded buff moth (Euthemonia Russula, Stephens), perfect insect, caterpillar, and pupa. The clouded buff moth measures about an inch and a half in the expanse of its wings. It frequents heaths and commons. The male generally flies in the afternoon, and may be observed during the day resting on furze-bushes and rough shrubs; but the female is seldom to be seen, as she generally conceals herself at the roots of plants or bushes, amidst dense vegetation. She is, moreover, far more sluggish in her habits than the male, numbers of the latter being often noticed active on the wing around her resting-place.

In the male the chest and anterior wings are pale yellow, the anterior margin near the apex, the inner margin, and long basal hairs bright sanguineous; posterior wings and abdomen yellowish white, the former with a dusky lunate spot on the disc, and a marginal fringe of the same colour. Shaft of the antennæ and legs rufescent. In the female the antennæ, head, thorax, and anterior wings are reddish or fulvo-rufous, the margins of the latter, the nervures and central lunule, bright sanguineous. The posterior wings are fulvous; with the base, an ovate spot near the centre, and the margin dull black.

The caterpillar is of a dusky tint, with yellow spots along the sides, and dull orange hair closely set in fascicles. Various grasses, plantain, hound's-tongue, &c. constitute its food. It changes in May to a reddish brown pupa, shrouded in a web upon the ground. The perfect insect appears in June.

The pink underwing (Callomorpha Jacobæa), perfect insect, caterpillar, and pupa. This beautiful moth is extremely abundant in certain localities. It is partially diurnal in its habits, and in favourite spots great numbers are often seen together, flitting about or resting on the stems of the ragwort. The head, body, and limbs are black; the anterior wings ashy brown, with a longitudinal streak of scarlet parallel to the anterior margin, and two roundish spots of the same colour on the external margin. The hinder wings are bright sanguineous on both surfaces, with a posterior narrow fringe of ashy brown.

The caterpillar of this species is to a certain extent gregarious.

The double-o moth (Cymatophora Oo), perfect insect, caterpillar, and pupa. This moth is local in its distribution, being rare in some places and tolerably abundant in others. It is nocturnal in its habits.

The head and thorax are of a pale ochre-yellow, sprinkled with dusky; the anterior wings are pale yellow, with a pale ferruginous mark near the base, and finely reticulated with the same colour, two rings something like O O appearing in the centre of the wings. Reticulations and a narrow line are conspicuous along the outer margin. The hinder wings whitish, with a tinge of buffy yellow. Expanse of wings about one inch and a quarter.

The caterpillar feeds on the oak, and the perfect insect appears in May and June.

The orange underwing (Brepha Parthenias), perfect insect, caterpillar, and pupa. The brephæ, observes Mr. Stephens, "are distinguished by the beauty of the under surface, and the liveliness of the colouring of the posterior wings, which are generally orange or flavescent with black or dusky fasciæ and margins;" the palpi are concealed, and the head is densely pilose.

This elegant species is diurnal in its habits, appearing early in the spring, and flitting about in wooded places on rapid but vacillating pinions, generally over the tops of the bushes or patches of underwood, and occasionally descending and settling near little pools of water, but ever on the alert, and flitting off on the least alarm. It is very local in its distribution, being common in a few places only.

The general colour is fuscous. The anterior wings are sprinkled with cinereous, and marked with several obscure whitish strigæ; two decided spots are seated on the anterior margin; the first forming a transverse bar. The posterior wings are dull orange, with the base and inner margin broadly black, with an interrupted transverse bar of the same colour, and also a posterior marginal fringe. We may observe, however, that in the arrangement of the markings there is considerable variation. The caterpillar is yellowish green, with a bluish black lateral line, and some black spots. It feeds upon the leaves of the poplar and oak.

Fig. 3720 represents the caterpillar of the goat-moth in a willow-tree. Fig. 3721, the winter nest of the same caterpillar, in which it hybernates. Fig. 3722, pupa in its cell. Fig. 3723, *a*, the pupa of Cossus, compared with *b*, the pupa of the clear-wing hawk-moth (Ægeria asiliformis). Fig. 3724 represents—1, the lappet moth (Gastropacha quercifolia); 2, the emperor moth (Saturnia Pavonia); 3, the oak egger moth (Lasiocampa Quercûs); 4, the small egger moth (Eriogaster Lanestris); 5, the great tiger moth (Arctia Caja); 6, the cream-spot tiger moth (Arctia Villica); 7, the ground lackey moth (Clisiocampa castrensis); 8, the glory of Kent (Endromis versicolora).

The lappet moth, perfect insect, caterpillar, and and chrysalis (Gastropacha quercifolia). The lappet moth seems to vary considerably with respect to the numbers in which it makes its appearance, being rare during some seasons, and abundant in others; in some districts, moreover, it is in greater plenty than in others. The name of lappet moth is taken from a peculiarity in the caterpillar, which has each segment furnished with fleshy lateral appendages or lappets; and though the term is only applicable to the caterpillar, it has been transferred to the perfect insect, and universally adopted. The sexes of this moth vary considerably; the body and antennæ are dusky, or of a deep ferruginous brown; the wings are of the same tint, the anterior pair having three oblique waved stripes, and a central black spot; the hinder pair are unspotted. The female exceeds the male in size, and is of a lighter hue generally, with the stripes darker. Occasionally the stripes are almost obsolete; sometimes remarkably broad and deep; and occasionally the posterior wings have a few dusky markings. When at rest, the wings are deflected, and the moth resembles a withered oak-leaf in form and colouring.

The emperor moth, perfect insect, caterpillar, and pupa (Saturnia Pavonia). Heaths and marshy places are the haunts of this beautiful moth, of which the males may be often seen during the warm afternoons of summer, playfully flitting about in quest of their less active mates. This species is by no means uncommon, and is rather widely spread.

The emperor moth is of considerable size, measuring two inches six or ten lines in the expanse of the wings, the female often exceeding three inches

In the male the body is fulvous; the anterior wings are griseous, powdered with whitish, and with three purplish stripes edged with black. Between the two anterior stripes is an ocellated spot, of large size, with a black pupil, a white ring, encircled with black, and a bluish lunule towards the base of the wing. The apex of the wing is purplish, with a few black, white, and rufous spots. The hinder wings are tawny, with a ferruginous tinge, and an ocellated spot very closely resembling that on the anterior wings. The female is of a paler colour generally; but both sexes vary in markings, and sometimes in the female the wings are beautifully suffused with purplish.

The caterpillar is gregarious, and feeds on the heath, blackthorn, alder, oak, willow, birch, &c., and also on the leaves of the strawberry.

The oak egger moth, caterpillar and perfect insect (Lasiocampa Quercûs). In the New Forest, Hampshire, in various parts of Devonshire, and certain isolated localities, this moth is not uncommon, while in other localities it is rare. In the extent of its wings it nearly equals the emperor moth; and, as in that species, the male often flits about during the sultry afternoons of summer.

The general colour of the male is deep chestnut brown; the wings have a broad yellow band margined abruptly on the inner edge, and gradually shaded off towards the hinder margin of the wing, which has a broad brown fringe: the anterior wings have a central spot of white, usually of a triangular form, and a conspicuous yellow patch at the base. The female exceeds the male in size, but the general tints are paler: both sexes are subject to variations of colour.

The small egger moth, caterpillar and perfect insect (Eriogaster Lanestris). This species is common in different localities, abounding some years and rare in others. Occasionally nests of its caterpillars may be seen in the hedges, for the caterpillars, or larvæ, are gregarious, and make a common tent, in which they crowd together; this they enlarge from time to time, leaving it during the night, when they search for food, and returning to it in the morning at daybreak. Before assuming the pupa stage they quit this silken tent, and seek the surface of the ground, where they inclose themselves in an oval rigid cocoon, whence the perfect insect emerges in the months of February and March.

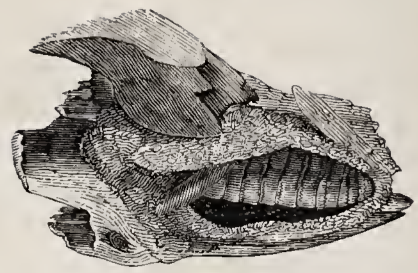
In the moth the thorax is griseous; the abdomen fuscous, with a paler apex; the anterior wings are subferruginous, with a large white spot at the base, and, in the male, a dark cloud in the centre, and an incurved white line beyond a central white spot; the hinder margin ashy grey. The hinder wings are grey, with an obsolete central line of white. Extent of wings one inch two or four lines. The colour in both sexes is subject to variation.

The great tiger moth; caterpillar, pupa, and perfect insect (Arctia Caja). The tiger moths (Arctia) are remarkable for the brilliant and showy contrasts of their colouring, which render them very attractive. The body is stout and robust; the larvæ are solitary, thickly clothed with long pencils of hairs, each pencil arising from a tubercle; when touched they roll themselves into a ring. The pupa is inclosed in a loose extended web.

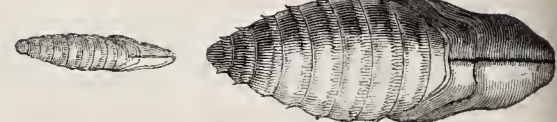
The great tiger moth is a very beautiful species, and is everywhere in tolerable abundance. It is subject to considerable variety in the arrangement of its markings and its tints. In general the thorax is brown, with a narrow white ring anteriorly; the body reddish white, or red, fasciated with black. The anterior wings are ornamented with white or cream-colour, and black or brownish black in distinct abrupt patches; the hinder wings are red, with glossy bluish black marks. The caterpillar is black, hirsute, with three bluish tubercles on each segment laterally. It feeds on various plants, as lettuces, chickweed, &c. The moth appears in spring.

The cream-spot tiger moth, caterpillar and perfect insect (Arctia Villica). This elegant moth is rare in some districts, but common in others. Like the preceding species it is subject to considerable variation of colouring. Generally, however, the anterior wings are black, relieved by several abrupt

3724.—Group of Moths, Caterpillars, and Pupæ.

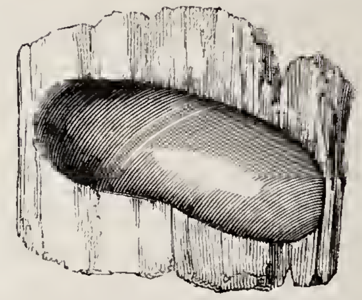


3722.—Nest of Goat-Moth.

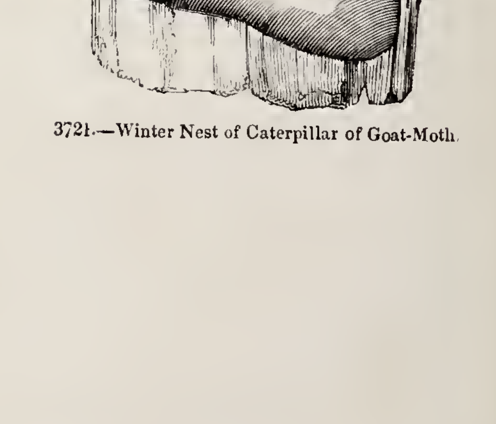


3723.—Pupa of Cossus and of Egeria.

3719.—Group of Moths, Caterpillars, and Pupæ.

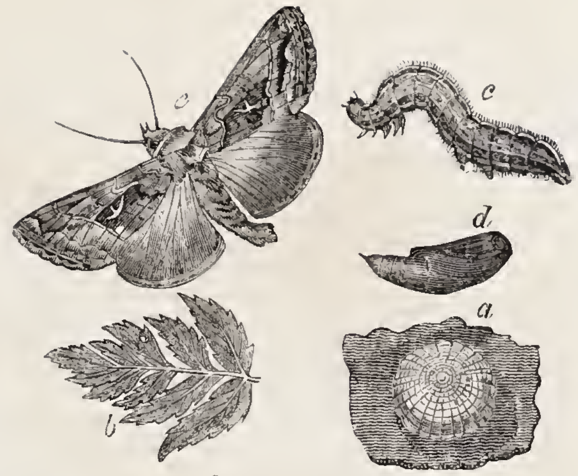


3721.—Winter Nest of Caterpillar of Goat-Moth.



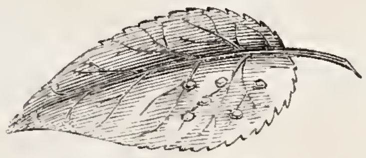
3720.—Caterpillar of Goat-Moth.

3725.—Geometric Moths, Caterpillars, and Pupæ.



3727.—Gamma-Moth.

3732.—Caterpillars of Clifton Nonpareil.



3728.—Eggs of Puss-Moth.

3733.—Caterpillars of Clifton Nonpareil.

3730.—Caterpillar of Stauropus Fagi.

3729.—Transformations of Puss-Moth.

3726.—Group of Moths, Caterpillars, and Pupæ.

3731.—Crimson-underwing Moth and Caterpillar.

white spots of different sizes; the hinder wings are yellowish, more or less spotted with black; thorax black; abdomen rufous, with a dorsal and lateral series of black spots. The caterpillar is dusky, with blackish hairs and fulvous tubercles; the head and legs are red. It feeds on various plants, but prefers chickweed. The perfect insect appears in June or July. The males are frequently seen abroad on the wing in the afternoon during warm weather; but the female is indolent in its habits.

The ground lackey moth, caterpillar, pupa, and perfect insect (Clisiocampa castrensis). In the genus Clisiocampa the wings are very acute at the apex, reversed when at rest, short in the male, elongate in the female. The larvæ are gregarious, wandering about irregularly in troops, and frequently changing their silken tent. Before assuming their pupa state, they separate, and retire each to some retreat. The pupa is inclosed in a double web of powdery silk. This species of moth seems to be limited to certain districts in our island, as the coasts of Essex, Kent, and Devonshire, and the Isle of Sheppey, being littoral in its habits, and never found in the Midland counties. It varies considerably in its markings. The thorax is yellowish, the abdomen tawny; the anterior wings of a straw-colour, with two tawny or chestnut stripes, sometimes united, sometimes forming two distinct bars across the wing. The posterior wings are fawn-coloured, with an obscure streak across. The female is larger, and of a darker colour. The caterpillar is hairy, and bluish, with irregular red and black streaks above, and red lateral lines. It feeds on various plants, as sea-wormwood (Artemisia maritima), birch, plantain, carrot, &c. It undergoes its pupa change in July, and the perfect insect appears in August.

The glory of Kent, caterpillar, pupa, and perfect insect (Endromis versicolora). This beautiful little moth is very local in its range in our island, and by no means common in any district.

In the male, the thorax is white and fulvous, the body fulvous, with a black patch on the second segment. The anterior wings are grey, with two dusky stripes across, with a black lunule between them. At the apex of the wing are three triangular, semi-transparent, white spots, and each nervure has a dilated whitish streak. The posterior wings are orange-tawny, with an undulated dusky stripe and central lunule; there is also a dusky patch on the anterior margin bordered with white. The female is larger than the male, and of a paler colouring. Expansion of wings two inches and four or six lines; it often exceeds three inches.

Fig. 3725 represents a group of moths of the Geometric family (Geometridæ), so called, as we have before shown, from the movements and attitudes of the caterpillars:—1, the Swallow-tail moth (Ourapteryx sambucaria); 2, the Lunar thorn moth (Geometra lunaria); 3, the common V-moth (Grammatophora vanaria); 4, the large Emerald moth (Hipparchus papilionarius); 5, the Lilac beauty (Pericallia syringaria); 6, the Blood-veined moth (Bradyeptes amataria); 7, the Mottled Umber moth (Hibernia defoliaria).

The Swallow-tail moth (Ourapteryx sambucaria), perfect insect, caterpillar, and pupa.

The genus Ourapteryx contains only one European and about six exotic species, distinguished at once by the form of the posterior wings, which terminate each in an elongated tail-like process, as in several diurnal butterflies.

The swallow-tail moth is spread over the whole of Europe, and is not uncommon in the woods and larger gardens of our island; it is frequent about Paris. The flight of this moth is very rapid, but it is seldom seen abroad by day, the hours of dusk and those preceding twilight being its times of activity. The caterpillar is of a cinnamon brown, furrowed longitudinally, and presenting three tubercles, two placed laterally on the sixth ring and one above on the ninth. It lives principally on fruit-trees, but it is said to feed also on the leaves of the elder, whence the name Sambucaria; there is reason, however, for doubting the truth of this statement. The pupa suspends itself from the branch by means of several delicate filaments of silk, to which a frail cocoon is attached, consisting of silk interwoven with bits of dry and withered leaves. The moth comes forth at the end of June or the beginning of July. The wings are of a pale yellow above, powdered with greenish grey, and marked with three transverse streaks of dusky yellow. The two first streaks are nearly straight, and in the interval between them is a little dusky crescentic mark; the third streak is somewhat flexuous. At the base of the posterior angle of the hinder wings are two black spots, of which the outermost is ocellated with a rufous pupil. The fringe of the upper wings is rufous. Expansion of wings from two inches to three and a half.

The lunar thorn moth (Geometra lunaria), perfect insect, caterpillar, and pupa.

This species not only varies greatly in size, but in colouring, the general tint being sometimes of a pale ochre yellow, more or less varied and sprinkled with rufous, sometimes of a lively orange, and sometimes of a beautiful rose red. Generally each wing is marked in the centre with a little white transparent crescent; and sometimes the crescent exists only on the upper wings, sometimes on the under wings. This circumstance, joined with other differences, has induced many to consider the varieties of this moth as distinct species, but it is proved, by rearing the caterpillars till the perfect moth appears, that, vary as the latter may, they are all referable to the same species.

The caterpillar varies greatly in its colour, and often assumes that of the young shoots of the tree or bush on which it lives.

In England the lunar thorn moth is by no means a common species.

The common V-moth (Grammatophora vanaria), perfect insect, caterpillar, and pupa.

This moth is very common in gardens around London, and in most other parts of England, where the caterpillar commits extensive ravages on gooseberry-bushes, stripping them of their leaves, on which it feeds. During some years it swarms in hosts, which prove very destructive. The colour of the moth is subject to variety; in general the wings are of an ashy grey, powdered with a darker tint, and mottled with four black spots on the anterior edge, whence a faint slender line extends from the second to a mark like the letter V. On the outer edge the wings have a dusky wash. In some varieties the wings are white, marbled with cinereous; in others they are of a sooty black. The caterpillar is greenish, spotted with black, and with a dorsal line of yellow, and lateral lines of the same colour. The pupa is brown.

The large Emerald moth (Hipparchus Papilionarius), perfect insect, caterpillar, and pupa.

This species is remarkable among the geometric moths from its great size, its beautiful green colour, and the elegant contour of its wings, which resemble those of a diurnal butterfly. Like the butterfly, it raises up its wings during repose, and it is from this circumstance that Linnæus gave it the title of Papilionaria. It is not a common insect in our island.

The emerald moth has the wings of a fine grass green, the anterior pair having two or three interrupted transverse marks of grey,—the posterior wings generally two such stripes. The antennæ are reddish white. The caterpillar is sluggish in its movements, and feeds on the leaves of various trees, as the lime, birch, alder, hazel, &c.; it is of a green colour, with a yellowish lateral line and red tubercles on the back. The pupa is elongated, and of a reddish brown colour. The perfect insect appears about the middle of July.

The Lilac Beauty (Pericallia syringaria), perfect insect, caterpillar, and pupa.

The lilac beauty is by no means a common species in our island, but has been captured in various places: it is far more abundant in France, and may be found in the gardens about Paris. The anterior wings are varied with yellowish and grey, and tinted with purple or purplish rose-colour; on the anterior edge are some purplish white dashes, and a little before the middle is an angular violaceous stripe, with two others behind common to both the wings; of these the first stripe is brown, the second brown and violet, with some black spots on the posterior wings, towards the inner margin. Towards the apex of the anterior wings is a violaceous lunular spot. The posterior wings are of a greyer tint. The female exceeds the male in size, and is of a paler colour.

The caterpillar of this elegant species is remarkable from the oddity of its form and its attitude during repose. Instead of keeping its body straight and stiff, as is the case generally with those of the geometric group of moths, it folds itself into a curved line, with the head a little raised up. Its colour is generally brownish red, with a black dorsal band extending over the four first rings. Its form is thick, and a long slender horn is carried on the seventh ring. Besides this horn, there are two little conical tubercles on each of the fifth and sixth rings, and on the sixth and seventh two little white excrescences.

It feeds on the lilac, the jasmine, and privet; and hence the moth frequents gardens, and parks, and pleasure-grounds, rather than woods or fields.

The pupa is not less remarkable than the caterpillar: it is of a short figure, and is almost rounded anteriorly, broad in the middle, and terminates abruptly in a point. It is of a dull yellow tint, with the upper parts chestnut. It is always found fixed perpendicularly, the head upwards, to a young twig, and is retained in its position by a number of threads, which are united together at its apex.

The Blood-veined moth (Bradyeptes amataria), perfect insect, caterpillar, and pupa.

The genus, founded by Mr. Stevens for this species, is characterized by the very acute anterior angle of the wings, and the angulated hinder margin of the posterior wings, combined with the oblique stripes which pass through their disc, from the apex of the anterior wings to the inner edge of the posterior. The blood-veined moth is rather local in its distribution in our island, being extremely abundant in some places and rare in others. It is common in France. Its flight is sluggish. The wings are of a pale yellowish grey, finely powdered with brown, with a very oblique purple red or sanguineous streak crossing both wings from the apex of the anterior to the middle of the inner edge of the second pair. At the base of the anterior wings is a pale brown transverse stripe, and a dusky stripe at the posterior margin of both wings winds flexuous from the apex of the fore wings. The edges are fringed with red, and in fine specimens the hinder margin of all the wings is beautifully suffused with a rich sanguineous purple.

The caterpillar is very singular; it is cylindrical, but little elongated, with the fourth, the fifth, and the sixth rings much thicker than the others; the head is small, and buried under the first ring. The ground colour is umber, with several yellow streaks, one of which is dorsal and longitudinal, interrupted by black, and crossed by other lines forming lozenge-shaped marks on the intermediate rings, and bordered with black. It lives on various trees and shrubs, as the hazel, whitethorn, &c.

The chrysalis is also very curious; it is of a slender form, with a notch at the head. It is generally found enveloped in a slight network or thin tissue between leaves. The perfect insect appears in July.

The Mottled Umber moth (Hibernia defoliaria), perfect insect, winged male and wingless female, caterpillar, and pupa.

In the genus Hibernia the anterior wings are long and thin in the male; in the female the wings are either wanting or very rudimentary. The species are all autumnal, beginning to appear as perfect insects at the fall of the leaf.

The mottled umber moth is common all over Europe. In our island it abounds around the metropolis, frequenting gardens, orchards, woods, and copses. It is subject to considerable variety. The female is wingless, yellow, and dotted with black. The caterpillars swarm during some years, and become extremely destructive in orchards, stripping the fruit-trees of their leaves; this is particularly the case in France, where they have occasionally committed great havoc.

The females of this moth—being unable to fly from the absence of wings—remain fixed on the twigs or branches of the tree, the pupa having there undergone its change; and they deposit their eggs on the leaves in countless numbers, whence in the spring issue destructive hordes, of the effects of which the leaves of pear-trees often present mournful evidence.

Fig. 3726 represents—1, the dark crimson underwing (Catocala sponsa); 2, the silver Y-moth (Plusia gamma); 3, the green silver-line moth (Hylophyla prasinana); 4, the green brindled crescent moth (Miselia oxyacanthæ); 5, the sallow moth (Xanthia cerago); 6, the spotted sulphur moth (Erastria sulphurea); 7, the large holly moth (Sarrothripus ilicanus).

The dark crimson underwing (Catocala sponsa). Perfect insect, caterpillar, and pupa.

The moths placed by entomologists under the genus Catocala are among the largest and the most beautiful of European Lepidoptera. They are active and vigorous, and fly during the day if even slightly disturbed; as evening approaches they are all animation, darting along with great rapidity. During repose the wings are slightly deflexed, and a little expanded, forming a broad triangle; their edges are deeply crenate, and the posterior pair are mostly of a brilliant crimson, with black fasciæ and margins.

In our island the dark crimson underwing is rather local in its distribution. In France it is occasionally very abundant in the oak woods, and is common in Hungary. The female exceeds the male in size, but both sexes are subject to variations both of magnitude and colouring, whence some naturalists have increased the number of nominal species. Generally the head and thorax are deep fuscous, freckled with black; the anterior wings are of a deep yellowish ash-colour, clouded with fuscous and with dark transverse undulated streaks, two of which in the middle of the wings are considerably angulated; and between them is a yellowish white patch representing marks somewhat resembling the letters J. G. Between these and the inner margin is a pale rhombic or somewhat rounded spot, flavescent or cinereous, edged with blackish. The posterior wings are of a rich crimson with a narrow flexuous black fascia and a posterior broad belt with a fuscous fringe. The caterpillar is of a brownish red, variegated with pale blue; some of the anterior as well

as the posterior segments are tuberculated. The pupa is bluish, and the insect appears towards the end of June.

The silver Y-moth (Plusia gamma). Perfect insect, caterpillar, and pupa. The Plusiæ are brilliant moths, eminently distinguished for the splendour and richness of their colouring; all the species have the wings more or less adorned with metallic pencillings, dots, or bands, upon a rich purplish or rufo-fulvescent ground. The thorax has a full crest, and the upper surface of the body is generally furnished with tufts of hair, like scales. In their habits these moths are diurnal; and they glitter in the sun as they extract the nectar from their favourite flowers, exposing their gorgeous liveries to view, and flitting about with great address and elegance. It is indeed a general rule, that animals attired in a brilliant dress affect the full blaze of day, while those of sombre hues or of dusky markings come forth with the shades of evening, with the gloom of which their colours harmonize. The caterpillars in walking bend their backs, and are hence termed half-loopers; they spin a delicate silken web, and change to a shining pupa, armed with a sharp spine at the apex. The present species is common in most parts of England, and is spread not only over Europe, but extends its range through a great part of Asia, and a closely allied species exists in North America. It is active on the wing during the early part of the day, and also in the afternoon, both before and after dusk. The general colour of the body is deep ashy grey. The anterior wings are varied with griseous and roseate fuscous, often with a silvery tinge. On the disk, which is almost black, is a little silvery mark, having the form of the Greek letters γ or λ, or the English letter Y. The hinder wings are of a dusky grey, with a blackish marginal band. The caterpillar is green, with a brown head, a lateral yellow streak, and six white dorsal lines. It feeds on a great variety of herbage.

The green silver-line moth (Hylophila prasinana). Perfect insect, caterpillar, and pupa.

This species belongs to the Tortricidæ of Stephens, a family of small moths remarkable for the great variation to which the species are subject. During repose they rest with slightly deflexed wings, and from the breadth and shortness of the wings assume a bell-like form. The larvæ generally reside within the covert of a leaf, which they have rolled up so as to form an envelope. Some, however, live in the pulp of fruits: they are very active, and run with great rapidity either backwards or forwards.

The green silver-line moth is not uncommon in the woods around London and in other parts of England, and extends over the whole of temperate Europe. The anterior wings are green, with three oblique streaks of white; thorax green, with four white stripes. In the male the anterior margin of the apex and hinder margin are fulvous. Posterior wings yellowish white.

Both sexes vary considerably in the intensity of colour.

The caterpillar is pale yellowish green, with a yellow lateral line, and minute dark specks; two red lines at the tail. It feeds on the oak, ash, alder, beech, &c. The pupa is reddish brown, sprinkled with an ashy powder: it is enclosed in a firm silken cocoon. The perfect insect appears in June.

The green brindled crescent moth (Miselia oxyacanthæ).

This species is one of the most beautiful of its genus; it is, however, far from being uncommon; but from the lateness of its flight is seldom seen on the wing: on the continent it is widely spread.

The anterior wings are of a beautiful yellowish brown, prettily varied with pale reddish and green; the latter colour predominating on the inner margin. Two blotches, of large size and irregular form, are of a pale colour: under the orbicular blotch is a third blotch of an oval form; a dusky line crosses the base of the wing, followed by an undulated stripe. The under wings are of a greyish yellow, tinged with rufous at their extremity, and fringed with yellow. The colouring is subject to variety.

The caterpillar is fuscous, varied with black and white. It feeds on various plants, especially the black and white thorns: it moves slowly, and having eaten its fill, it quietly seeks the angle of a twig or branch for repose; and its colour blending with that of the bark of the tree, it is not readily detected. Generally four or five individuals are associated together. About the month of July it envelopes itself in a cocoon, sometimes among the leaves, sometimes on the ground. The moth appears at the end of September or the beginning of November.

The sallow moth (Xanthia cerago), Xanthia fulvago, Stephens.

This species is common around London and in other parts of England, and is spread on the Continent, but is more abundant in Germany than in France. It is subject to great variety. The anterior wings are always of a lively yellow, with marblings of a cinnamon colour, sometimes very decided, sometimes almost obliterated. The hinder wings are entirely of a dull white; and both these and the upper are of this hue underneath, with a wash of yellow on the edges.

The caterpillar is of a greyish brown, with a white longitudinal streak on each side of the body, and a black mark varied with white on the first ring. It lives principally on the birch, or on the willow, on the catkins of which it feeds till the leaves become developed. It assumes a pupa state protected by a cocoon of agglutinated earth. The perfect insect appears in August or September.

The spotted sulphur moth (Erastria sulphurea). Perfect insect, caterpillar, and pupa. Erastria sulphuralis, Stephens.

The species forming the genus Erastria are amongst the smallest of the Noctuidæ, and are, in our island at least, as rare as they are beautiful. They are diurnal in their habits.

The present species, though common in the south of France, is one of our rarest British moths. It has been occasionally captured, Mr. Stephens assures us, in Battersea fields, flitting amidst the flowers during daytime. It has also occurred near Margate and in other parts of Kent.

This moth is very elegant. The head and thorax are sulphur yellow, with dusky black spots. The anterior wings are sulphur yellow, with three black spots on the anterior margin, and two on the disk. At their base two broad black bands run parallel with the inner margin, and, extending about two-thirds the length of the wing, are united by an undulating black line, often glossed with a silvery hue. Parallel to the latter is another waved line, sometimes interrupted; the hinder margin is irregularly black. The posterior wings are dusky black, with a whitish fringe.

The caterpillar is grass-green, with a black dorsal line and a yellowish lateral streak: it feeds on the common field convolvulus, liseron des champs (convolvulus arvensis), and, according to Vieweg, on the ordinary willow. The perfect insect appears in July and August.

The large holly moth (Sarrothripus ilicanus). This genus belongs to the Tortricidæ of Stephens, and is one of the most conspicuous in that family, not only for the comparative magnitude of the species, but from their habits. They are apparently autumnal, making their appearance at the close of summer, and sometimes continuing during the whole of the winter.

Mr. Stephens enumerates and describes seven species, but it is doubtful whether all are distinct; indeed, the probability is that many, if not all, are only varieties referable to S. ilicana. Such is the opinion of M. Godart, who regards the whole of the presumed species as identical, and refers them all to his Sarrotripa de Revay, or Sarrothripa Revayana.

The anterior wings are of a greyish white, more or less marbled with brown, and with a broad transverse brown belt; sometimes there are spots on each side of this belt—sometimes zigzag lines; the hinder wings are pale greyish brown, varying in intensity.

The caterpillar is of pale green, with thinly set, long, white hairs. It is found at the end of June on the willow (Salix caprea). At the beginning of July it constructs a cocoon, of a brilliant snow-white tissue in the form of a boat truncated at one of its extremities; the moth appears in about three weeks. It is more common in the north than in the south of France. In our island it is not uncommon in some districts. Many of the pupæ, as it would seem, pass through the winter in that condition, and undergo their change early in the spring, perfect insects having been taken in March. The same observation will apply equally to other species of moths which ordinarily appear late in the summer or in the autumn.

Fig. 3727 represents the Plusia gamma: *a*, the egg, magnified; *b*, the egg on a leaf, natural size; *c*, the caterpillar; *d*, the pupa; *e*, the moth. Fig. 3728 represents the eggs of the Puss moth (Cerura vinula). Fig. 3729, the transformations of the puss moth—*a*, the egg; *b b b*, young larvæ; *c*, the full-grown larva, remarkable for its grotesque attitudes; *d*, the pupa; *e*, the moth. Fig. 3730 represents the strange and grotesque caterpillar of Stauropus Fagi; it is rarely to be met with. Fig. 3731, the crimson underwing and caterpillar. Fig. 3732, the caterpillars of the Clifton nonpareil (Catocala fraxini) on the poplar. Fig. 3733, the same caterpillars, more advanced.

Fig. 3734 represents—1, the Ghost moth (Hepialus humuli); 2, the Gold swift (Hepiolus hectus); 3, the Honey moth (Galleria cereana); 4, the small Ermine moth (Yponomenta evonymella); 5, the dark six-cleft-plume moth (Alucita hexadactyla); 6, Linnæus' moth (Œcophora Linneella); 7, the Silver-spotted moth (Argyrolepia Lathoniana).

The Ghost moth (Hepialus humuli), female adult, caterpillar, and chrysalis.

This moth is common both in England and on the Continent, making its appearance in June or July. It takes its name of Ghost moth from the manner in which the male becomes in the dusk of twilight alternately visible and invisible; for the upper surface is silvery white, the under surface dusky brown, and as it flies it is continually exposing, during its vacillating movements, first the upper surface and then the under, thus showing itself for an instant and then becoming suddenly lost. It frequents hop-grounds, and the plants often greatly suffer from the ravages of the caterpillar, which is an underground feeder, devouring the roots of the hop and thus destroying the plant. Towards the end of April or the beginning of May it fabricates for itself a long cylindrical cocoon, of silk intermingled with earth, of which the posterior extremity is closed by a few lax threads. The chrysalis is reddish brown with black stigmata. When the moth is ready to emerge, the chrysalis pierces by means of the spines on its head the anterior or firm end of the cocoon, and by the aid of little denticulations, with which the rings of the abdomen are provided, it pushes itself forwards till the sheath of the wings is above the surface of the ground; after this the insect works to liberate itself entirely.

The female has the upper surface of the wings of an ochre-yellow, with two oblique bands of yellowish red; the under wings are dusky, with the extremity reddish. In both sexes the body is yellow, the limbs brick-red.

The caterpillar is of a yellowish white, with the head, the upper part of the first segment, and mark on the second and the anterior limbs, of a glossy brown. The jaws and stigmata are black, and on the ten last rings are some little elevations of a yellow colour, from each of which springs a small blackish hair.

The Gold Swift (Hepiolus Hectus). This species, which is common in our country, frequents the sides of woods and shady lanes, appearing in the month of July. The male is remarkable for its strange mode of flight; it elevates itself to about the height of a foot or two above the ground, and sweeps without advancing, from side to side, like a pendulum, continuing this vibratory movement for a considerable time. Should the entomologist approach and aim at its capture, it instantaneously falls to the ground and there rests motionless, with the limbs folded against the body. It is very probable that the females also occasionally practise this singular mode of flight. De Geer has given to this moth the name of 'Phalène pattes-en-masse,' because its hind limbs, in the place of the leg and tarsus, are furnished with a glossy club-like mass, in the form of a flattened pear, articulated at the small end to the extremity of the thigh.

The male has the upper surface of the first wings of a light reddish brown; with two oblique bands and a terminal row of small spots of a glossy yellowish white; the second wings are of a dusky brown.

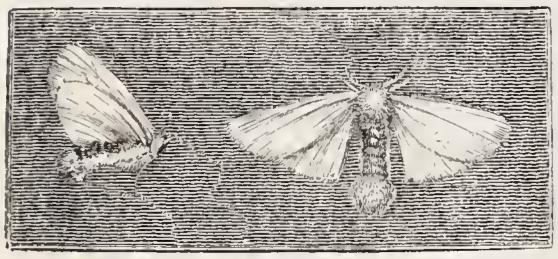
The female has the first wings of a ferruginous brown, with grey markings, and the limbs as usual; the clubbed termination being peculiar to the male.

The caterpillar is an underground feeder, and is found at the roots of the heath.

The Honey Moth (Galleria cereana). This moth is on the whole a rare species, or, at least, is locally distributed. Mr. Stephens, however, states that a considerable number of specimens have been captured at Birch Wood, near Bexley, others near Epping, and also in various parts of Suffolk and Devonshire, at the end of June or the beginning of July.

The caterpillar feeds on honey, wax, and bee-bread, and in some places is known to make great havoc in the hives; it destroys the comb as it eats its way, investing the fragments with a web which it spins as it goes on; and as hundreds are at work together, the destruction of the whole of the combs is soon accomplished. M. Godart says that on emerging from the egg it fabricates for itself with the substance of the wax a cylindrical tube fixed to the sides of the comb, or on the cells, in which it passes its existence secure from the attack of the bees, upon whose works it riots. This tube is proportioned to the size of the caterpillar, and at first is not thicker than a thread; but in proportion to the growth of the caterpillar it is lengthened and enlarged so as to give freedom of movement to its tenant; these tubes are sometimes a foot long, but mostly about five or six inches. Their interior is lined with fine silk, closely woven, and their exterior is covered with grains of wax and excrementitious matter all compacted together. In some hives three hundred of these destructive pests

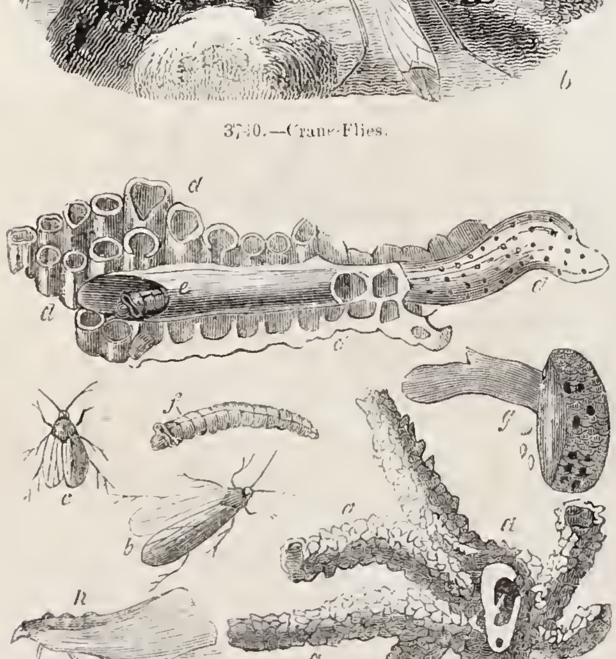
3736.—Buff-tip Moth and Caterpillar.



3737.—Females of Crown and Golden-tailed Moths

3735.—Encampment of Larvæ of Small Ermine-Moth.

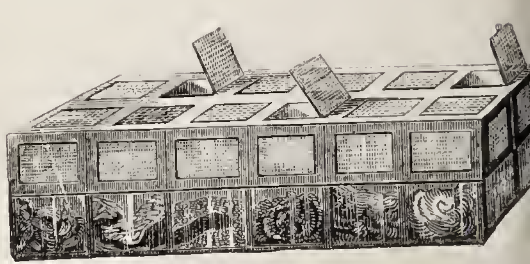
3740.—Crane-Flies.



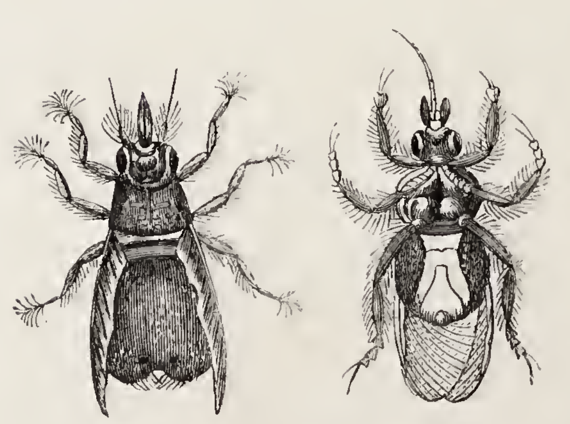
3738.—Galleria Moths

3734.—Group of Moths

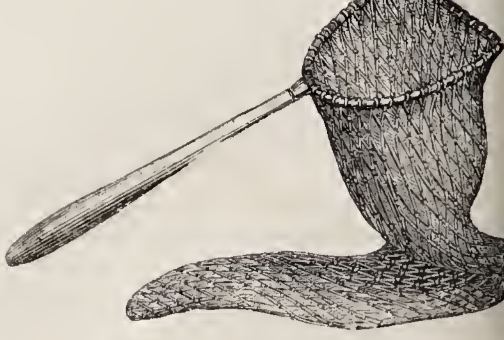
3739.—Tabby-Moth and Caterpillar.



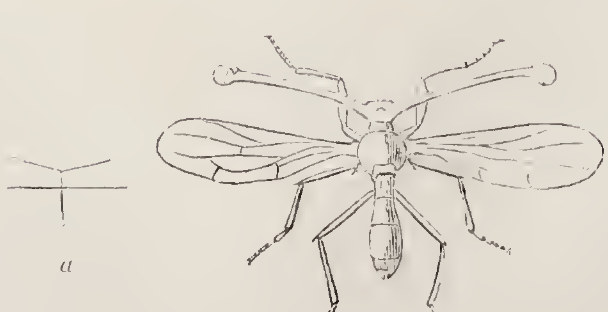
3743.—Breeding-Cage for Larvæ.



3741.—Hippobosca Hirundinis and Hippobosca Equina.



3745.—Water-Net.

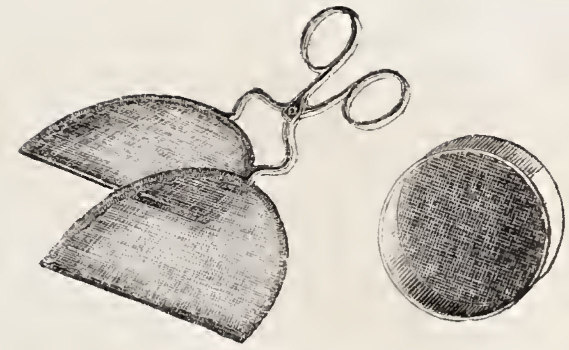


3742.—Diopsis Sykesii.

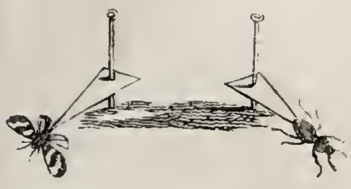
3744.—Larva-Box and Collecting-Box.

3746.—Butterfly-Net.

3747.—Clap Net.

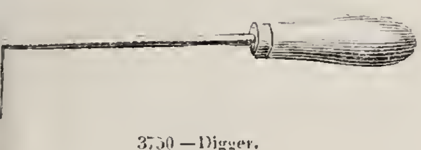


3748.—Ring-Net and Forceps.



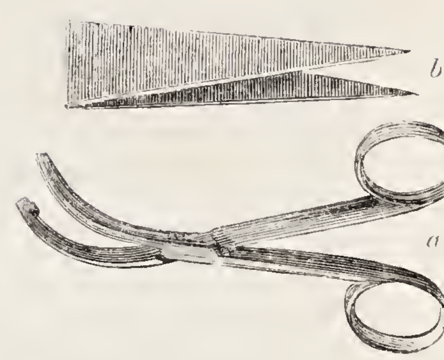
3753.—Mounting of small Insects.

3751.—Chip Collecting-Box.

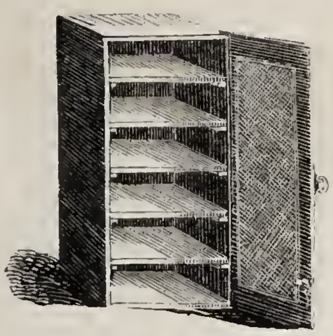


3750.—Digger.

3755.—Group of Centipedes.



3749.—French Beetle Forceps and Pliers.



3754.—Setting Board Frame.

3752.—Mode of Setting out Insects.

3757.—Julus terrestris, Oil-Beetle, and Wingless Bat-Louse.

3756.—Electric Centipede.

have been found, and the whole of the combs reduced to fragments, intermingled with dirt and webs. In various part of Suffolk the ravages of the 'miller,' as the caterpillar is called, are well known.

When full grown, the caterpillar constructs in its tube or gallery a cocoon of strong and closely woven silk, having the appearance of leather, and there changes into a reddish brown chrysalis.

In America an allied species displays the same habits, and is one of the pests of the bee-keeper.

The perfect insect appears first in April, and a second flight takes place in July. It is common on the Continent. This moth makes but little use of its wings, and rests during the day on the walls of buildings, or upon the covering of the bee-hives, which the female enters in order to deposit her eggs.

The male and female differ considerably in colouring, the wings in the latter being darker than on the former. The anterior wings are griseous, palish at the base, and darkest on the hinder margin. Near the inner margin are some purple brown streaks; the posterior wings are bright ashy grey, with the nervures and hinder margin dusky.

The caterpillar is flesh-coloured, with a chestnut brown head, and a palish line on the back.

The small Ermine Moth (Yponomeuta evonymella). In passing along the lanes or through the fields, we may often see the hedges for yards completely stripped of foliage by the ravages of the caterpillar of this species, which lives in troops of hundreds, all crowded together under a common tent, the tissue of which resembles crape; the troop having devoured the leaves at one station, move on to another, and spin a fresh tent; having stripped the foliage, they again move forwards, and repeat their movements at due intervals. Hence, though the hedges to a great extent are rendered leafless, they are crowded with filmy webs.

The perfect insect appears in July and August. The anterior wings are snow-white, with about four longitudinal rows of minute black dots; the posterior wings are brownish.

The caterpillar is ochre-yellow, with ten black dots on each side, and a brown head.

The dark Six-cleft-Plume moth (Alucita hexadactyla). This species is very common in gardens, the caterpillar living upon various species of honeysuckle. The wings on the moths of the present genus are remarkable for their beautiful structure, being composed each of six nearly equal plumes, consisting of a shaft fringed with fine cilia-like feathers.

This elegant moth deposits a single egg, or at most two, on the undeveloped flower of the honeysuckle, and in a short time a little flesh-coloured naked caterpillar is produced, which introduces itself into the calyx, and devours all the internal parts, still green; when one flower is thus destroyed it seeks a second, and so on, till at length it spins a white transparent cocoon, in which it undergoes its change.

The perfect insect appears in June. The wings are ashy grey, with irregular markings of brown; the tip of each plume has a dot of black.

Linnæus' moth (Œeophora Linneella; Glyphipteryx Linneella, Hübner). This species is common on the lime-trees in the vicinity of London, and appears to be local in its distribution. The caterpillar is not described. The anterior wings are orange-tawny, with the base and apex black, and three silvery dots placed in a triangle. The posterior wings are dusky, with a very slight metallic violet tinge. The habits of this little species are unknown.

The Silver-spotted moth (Argyrolepia Lathoniana). This speeies is so rare that one or two specimens only exist in the cabinets of entomologists. Mr. Stephens's words respecting this moth are as follow:—"Mr. Hawworth states that he has seen a single specimen of this fine insect, of which I believe a pair were taken near Tunbridge Wells, in July, 1831."

The anterior wings dusky gold colour, with a broad central fascia, two spots and some marginal dots of a pearly white or silvery hue. Posterior wings ash-coloured. Habits unknown.

Fig. 3735 represents an encampment of the larvæ of the small ermine moth on a fruit-tree.

Fig. 3736 represents the ravages of the caterpillars of the Buff-tip moth (Pygæra bucephala)—*a*, the full-grown caterpillar; *b*, the moth; *c c*, a legion of young caterpillars advancing along a leaf and devouring it half through as they march; *d*, the eggs.

Fig. 3737 shows the females of the Crown and Golden-tailed moths (Porthesia auriflua, and P. chrysorrhæa).

Fig. 3738 shows the destructive ravages of two species of Galleria: *a a*, galleries of the cell-boring caterpillar; *b*, the female moth; *c*, the male moth of Galleria alvearia; *d d d*, galleries of the wax-eating caterpillar, seen at the entrance; *e*, *f*, the same exposed; *g*, the cocoon; *h*, the moth of Galleria cereana.

Fig. 3739 represents the transformations of the Tabby moth (Aglossa pinguinalis), the caterpillar of which feeds on butter, on leather, and other similar materials: *a*, the caterpillar feeding on butter; *b*, *c*, *d*, the same feeding on leather, concealed under a web; *e*, the moth with its down rubbed off; *f*, the same in perfect plumage.

DIPTERA.—Two-winged insects, with a proboscis very variously modified, and with variable antennæ: the wings are membranous, veined, and transparent, and besides these there are halterers or balancers, and alulæ, which we have already described. As examples we may cite the common fly, the blue-bottle, the gnat, the crane-flies, and others. As illustrations, we select two species of crane-fly, Fig. 3740—*a*, Ctenophora flaveolata; *b*, Ctenophora ornata. Some Diptera are parasitic, as the Hippoboscidæ, termed Spider-flies by Réaumur, and which are stated to be viviparous, the parents producing pupæ instead of eggs or larvæ. Hence Latreille's terms of "Pupipara." These pupæ are of considerable size, and at first very soft, but the skin soon hardens into a solid crust, at first brown, then black, roundish, and notched at one extremity, where a glossy operculum is presented which will become thrown off like a hood at the last metamorphosis. This crust or case has no rings, as in the pupa of the other Diptera. Fig. 3741 represents the Hippobosca Hirundinis, Linn. (Ornithomyia avicularia?), and the Hippobosca equina. The former, with very narrow sickle-like wings, deposits its young in the nest of the swallow, and the perfect insect lives by sucking the blood of its feathered partners of the nest, whose warmth has contributed to its development. The Hippobosca equina, or Forest-fly, is notorious for its incessant attacks upon horses, and in some districts appears in great numbers. Another species, Hippobosca (Melophila) ovina, conceals itself in the wool of sheep, from the skin of which animals it derives its food. There are other species which have only the rudiments of wings. In the genus Nycteribia (the Batlice) there are no wings. Fig 3742 represents a curious dipterous fly (Diopsis Sykesii), a native of India, remarkable for the eyes being seated at the extremity of long footstalks, the antennæ being seated close to the eyes:—*a*, the natural size. See Mr. Westwood in 'Linn. Trans.' vol. xvii. pl. 2, p. 283; and pl. 4, p. 543. The species are numerous.

We will conclude our cursory review of insects by calling the attention of the young entomologist to the apparatus required for carrying on his active operations. Fig. 3743, a breeding-cage for rearing larvæ, with gauze doors and glass sides. Fig. 3744—*a*, a larva box; *b*, a pocket collecting-box. Fig. 3745, a water-net. Fig. 3746, a butterfly-net. Fig. 3747, a clap-net. Fig. 3748, a ring-net and pair of net-forceps. Fig. 3749—*a*, French beetle-forceps; *b*, pliers. Fig. 3750, digger for the bark of trees in the earth. Fig. 3751, a chip collecting-box with cork lining. Fig. 3752—*a*, the mode of setting out a butterfly; *b*, wasp; *c*, beetle, setting-needles and brush. Fig. 3753, method of mounting small insects with gum on slips of cardboard. Fig. 3754, a setting-board frame, in which to expose the insects to free ventilation till dry, and at the same time secure them from spiders, or Tineæ.

CLASS MYRIAPODA.

This class comprehends the Centipedes and Millepedes, creeping things which lurk during the day in obscure retreats, coming abroad in search of food during the darkness of night, and retiring with the dawn of day. These animals constitute a group termed by naturalists Myriapoda, the first order of insects according to M. Latreille, but really forming a distinct section or class of the subkingdom Articulata, and displaying affinities to the crustacea, scorpions, and insects, yet distinguished by characters of their own. They are composed of a series of distinct segments, and to every segment is appropriated one pair of limbs; sometimes indeed two pairs.

The head is furnished with jaws, antennæ, which are regarded as feelers, and eyes either simple or compound. Respiration is effected through spiracles, as in insects, whence air-tubes ramify over the internal viscera. Like insects, they undergo a metamorphosis, or rather several changes, before acquiring their perfect form; and the sexes are distinct.

Their movements are winding and serpentine: some are slow, gliding gently along; others, on the contrary, are active and rapid in the extreme. They feed on decayed vegetable and animal substances, on fruits, roots, &c., and many on living prey.

The Myriapoda resolve themselves into two tribes, one represented by the Millipede, the other by the Centipede. The first, Chilognatha, Latreille, the genus Julus of Linnæus, comprising the Millepedes, is characterized by the cylindrical form of the whole body: the antennæ are composed of seven joints; the first segment of the body, sometimes the second, is the largest, and presents the appearance of a corslet or little buckler. It is not until the fourth year in some, the fifth or sixth in others, that the pair of limbs on the several segments become doubled, and that maturity is attained. They live upon decayed animal and vegetable substances, and are found under stones, in the ground, at the foot of old walls, in the fissures and under the bark of time-worn trees. If we take the Millepede as an example of this tribe, we observe it to be elongated and cylindrical in form, divided into rings or segments, and capable of rolling itself up spirally into a ball. The segments are from forty to fifty in number, smooth, horny, and convex above. Each segment in the perfect animal is furnished with two pairs of short legs (certain segments excepted), by means of which the animal appears to glide along, without any effort, the legs being almost invisible as we look down upon the moving creature. The respiratory orifices or stigmata are placed on the sternal (or lower) aspect of each segment, and lead to a double series of aërating sacculi, whence tubes emerge, to be distributed on the internal organs. In addition to these breathing orifices a series of pores runs down each side of the body, exuding an acid secretion of unpleasant odour.

The mouth is furnished with two stout horny jaws, one on each side, as we see in caterpillars, acting against each other; their cutting edges are serrated, in order that they may be rendered effective in dividing the fibres of decayed wood or the dead roots of plants.

The female millepede deposits her eggs, which are very minute, in the earth or in the earthy powder of decayed wood, which is in fact a rich vegetable mould. We have said that the young undergo a series of transmutations before arriving at their perfect development. The progress of these changes has been watched by De Geer, Savi, and other zoologists, and are too remarkable to be passed by unnoticed. The young when first hatched are very minute, utterly destitute of limbs, quite smooth, and of a kidney shape, but of course so minute as to require a lens for examination. In the course of a few days afterwards they undergo a sort of moult, changing the skin, and then appear divided into about eight segments; a pair of simple eyes appear on the head, which is furnished also with two antennæ; the three segments following the head have each a pair of limbs. In a few days a second moult takes place, the body is enlarged, the number of segments increased, and the number of limbs augmented to seven pairs, one pair on each segment succeeding the head. At the age of a month, or thereabouts, a third change takes place, and the millepede appears with twenty-two segments and twenty-six pairs of feet, but of these the anterior eighteen pairs are only used in progression. The general form and aspect now approximates to that of the adult. Some time now elapses before the fourth moult, which gives thirty-six pairs of legs. Subsequently the male acquires thirty-nine rings, and the female sixty-four, with two pairs of limbs to every segment. But after this, two years elapse before the perfect development and maturity of the animal is completed.

Such is a summary of the observations recorded, to which it may be added, that the changes from the first to the fifth take place from the month of March, the time when the eggs are hatched, to the end of July or beginning of August.

Whether these changes are as precise as stated, we think a matter of doubt. At all events we have recently examined and sketched a female Julus of considerable size, with forty-six rings, and eighty-two legs on each side. The first segment after the head had a pair of limbs on each side, that is a double pair altogether; between the first and second segment appeared a distinct orifice; and then appeared only one limb on each side; to this succeeded two limbs on each side for every segment, excepting the three caudal segments, which were destitute of limbs.

The common Millepede (Julus terrestris) is too well known to need description: it lives in light vegetable mould in gardens or plantations, under old walls, stones, logs of wood, and the like; it feeds on vegetable matters. Our European Millepedes are all of small size; there is, however, a species found in Brazil, the Julus maximus, Linn., of the length of seven inches.

Certain millepedes are separated from the genus Julus in consequence of the form of the segments, which are not only less convex, but their outer margin is reflected up, and forms a projection with a point at its posterior angle. They are of small size, and found in damp places in the earth: they form the genus Polydesmus of Latreille. To those

in which the eyes are apparent, Dr. Leach gave the name of Craspedosoma. The Polydesmus complanatus (Julus complanatus, Linn.) is by no means uncommon in gardens. It is more active in its movements than the common millepede, and is capable of rolling itself up.

Another genus is termed Glomeris by Latreille. The species have much resemblance to the woodlouse (Oniscus), or rather the Armadillo Woodlouse (Armadillo, Latr.); they are oval in figure, and have the power of rolling themselves up into a ball, like the Armadillo, with which indeed they are often confounded by superficial observers; insomuch that from the comparison of actual specimens, we have drawn out the most palpable differences, to serve as a guide to young inquirers. In Glomeris, taking the Pill Millepede as our example, the limbs are small, and arise from a median abdominal line; they are short and numerous, and do not appear laterally beyond the jointed carapace or backplate.

In Armadillo (an Isopodous crustacean, as is also the common Woodlouse) the limbs are large, proceed from the sides of the abdomen, and extend beyond the back plate, excepting the hind pair. In the Pill Millepede (Glomeris) the head is larger and more concealed, the antennæ are short and end club-shaped.

In the Armadillo Woodlouse the antennæ are longer and filiform or pointed.

In the Pill Millepede the shelly covering is firm; in the Armadillo much softer, as in Oniscus. The terminal segment of Glomeris is large, of Armadillo small and triangular. In the latter the lateral edge of the dorsal armour along each side is serrated, in the former continuous.

The Glomeris, or Pill Millepede, is black, with yellow margins to the rings or segments. Armadillo is yellowish grey clouded with brown, or brown with yellow blotches; it exceeds the Pill Millepede in size. Both are common, and roll themselves up in the form of balls, and were formerly used in medicine. A species of Armadillo from Italy (A. officinalis) was employed on the Continent. The Pill Millepede, Glomeris marginata, Leach (Julus ovalis, Linnæus), is found under stones and amongst moss, and in the same situations as the common Millepede. Both the Pill Millepede and the Armadillo Woodlouse are abundant in the writer's garden: they feed on decomposed vegetable matters.

There is a singular little creature, the Jule à queue en pinceau, found in hothouses, under frames, under the bark of aged trees, and in the fissures of walls, which was placed by Linnæus in the genus Scolopendra; it belongs, however, to the present section, and constitutes the genus Polyxenus of Latreille. At first sight it appears very like the larva of that beetle well known from its destructive habits in museums, viz. the Anthrenus Musæorum: it is oblong in form, with tufts of little scales along the sides, and a pencil of hairs at the tail. There are twelve pairs of limbs. It is the only known species, and was termed Scolopendra lagura by the older writers. It varies in size from a line to two lines and a quarter in length; the body is brown: the head black; the caudal pencil of hairs white. Like the Jule, in general it feeds on decomposed vegetable substances. In one important point, however, it differs from the true Millepedes: the body is not invested with firm shelly plates, but is soft, and covered by a membranous investment. Like the Woodlouse, it is gregarious, numbers collecting together in the same hiding-place. We may here observe that the common Millepede and Pill Millepede are gregarious; but as far as our own observations go, not the Polydesmus complanatus, or flat-backed Millepede, which in some respects approaches in its manners, as it does in its appearance, to the predatory Centipedes, which are solitary, like carnivorous beings in general.

The second family of Myriapods (Chilopoda, Latreille) comprehends the Centipedes, &c.

Of these voracious creatures several species are well known in our island, but it is in the hotter regions of the earth that they are the most numerous and attain to the largest dimensions.

In the Centipedes or Scolopendræ the body is long and flattened, and covered above by a series of dorsal plates, and below by a separate series, the sides being simply membranous. This provision admits of a snake-like flexibility and of that rapidity of motion for which these Centipedes are so notorious. They are in fact daring and active carnivorous animals, preying upon insects and worms. Night is their season of activity; during the day they lie concealed under stones, beams of timber, in holes amidst brickwork, or even in the ground. Fitted for a life of rapine, they are very formidably armed; our British species indeed, though not very pleasing in appearance, are at all events not to be dreaded; but when we go into warmer climates, we find these creatures terrific from the wounds they inflict. If we examine them, we see that the mouth is not only provided with horny jaws as in insects, but with two terrible fangs jointed in the middle, sharp at the points, and perforated near the tip by a minute orifice through which a poisonous fluid is instilled into the wound, and which, in some species of large size tenanting India, South America, &c., often produces the most severe consequences, if not death. We have measured a specimen twelve inches in length and one inch and a quarter across the largest backplates; but if Ulloa be not indulging in extravagance, it was a pigmy to those of which he talks, and which he says measured a yard in length and five inches in breadth, inflicting a mortal wound. Let not our reader suppose that we give full credence to this statement; but, be this as it may, the annoyance which these creatures cause to Europeans visiting intertropical climates is of no trifling account. They creep into houses, lurk under articles of furniture and behind wainscots, hide themselves in drawers and similar places, and sometimes in beds, to the disgust and apprehension of all not familiarized with their presence. In the south of France, Spain, and Italy, a large species (Scolopendra cingulata, Latr.) is very common. In our country, among the species of small size which are indigenous, the most common is the forked Centipede, Lithobius forficatus (Scolopendra forficata, Linn.); it is found in the earth under stones, and is quick and active in its movements. The limbs are fifteen on each side. The general colour is tawny red. Length about an inch and a quarter, sometimes more.

A group of Centipedes, distinguished by the generic title of Geophilus, presents us with several species remarkable for their great length and slenderness, and the number of their limbs, which exceed forty-two on each side. They are tortuous in their movements, and by no means so rapid as the ordinary Centipedes; they live in the earth, and make their way through the minutest fissures or apertures with the utmost facility. Of the slender animals of this genus most, if not all, are phosphorescent, and gleam in the dark, though not so intensely as the Glow-worm. The Geophilus electricus may be often seen at night during the summer months on the grass of lawns or on garden walks, palely glistening like a luminous thread as it winds its tortuous way. The long-horned Geophilus (G. longicornis) is another species by no means uncommon; it is larger than the G. electricus, and broader in proportion. Under the genus Scutigera are placed certain strange-looking Centipedes, found in the south of France, in southern Europe, Madeira, &c., remarkable for the length of their limbs. None have yet been found on our island. The back is plated with eight scales, thickened behind and notched; the body beneath is divided into fifteen semi-rings, each carrying a pair of legs, with long and slender terminal joints; the eyes are large and compound; the antennæ long. The European species, Scutigera coleoptrata, is very active, running with great quickness; it conceals itself behind the beams and woodwork of houses, emerging at night, and traversing the floors in quest of food. India and America have their respective species, and they are among those unwelcome visitors which annoy the European, who is not easily reconciled to the presence of centipedes, Scorpions, and Scutigeræ in his apartments.

The group at 3755 represents—1, the pill Millepede (Glomeris marginata); 2, the common Millepede (Julus terrestris); 3, the flat Millepede (Polydesmus complanatus); 4, the Polyxenus, or brush-tailed Millepede—a, magnified; b, the natural size; 5, the long-horned Centipede (Geophilus longicornis); 6, the common Centipede (Lithobius forficatus); 7, the Scutigera coleoptrata.

Fig. 3756 represents the Electric centipede, shining at night. Fig. 3757 represents—a and b, Julus terrestris, compared with c, the oil beetle, Proscarabæus vulgaris, and d, the wingless bat-louse (Nycteribia Hermanni).

CLASS ANNELIDA

(RED-BLOODED WORMS, as the Common Worm, the Leech, the Lug-worm, and other aquatic species).

In the animals of this class we find the body of an elongated form, with soft semi-cartilaginous annulations at certain distances from each other, connected together by longitudinal and oblique muscles, enabling the animals to twist themselves in various directions; the whole is covered by a moist skin, indicating, by segments more or less apparent, the soft annuli. The first segment is furnished with a mouth, and—where they exist—with eyes, tentacles, &c.: the last segment is sometimes furnished with bristle-like appendages; or sometimes, as in the leech, it is dilated into a sucker. Each segment moreover is generally beset with short setæ or minute spines, of use in locomotion; and in some vascular tufts are present, constituting a respiratory apparatus. The blood is red, and there is a double system of veins and arteries. Each individual is bisexual. Most of these creatures are defenceless, and seek safety from their numerous enemies by retiring into holes which they bore in the soft earth, the mud, or sand. Some, as the Sabella and Terebella of the sea-shore, agglutinate around them particles of sand and the fragments of comminuted shells, which form a case in which they dwell. The Serpula, however, exudes a calcareous secretion, which hardening, forms a long twisted shell in which it resides, and from which it protrudes its head and beautiful respiratory tufts.

Cuvier divides the Annelida into three orders, Abranchiata (with no branchial tufts), Dorsibranchiata (with branchial appendages on the back), and Tubicolæ (tube-makers).

Of the Abranchiata the Earth-worm, the Naïs, the Leech, the Hair-worm, or Gordius aquaticus, are examples. In these a series of minute pores, ranged along each side of the body, lead to delicate sacculi, over which is thrown a mesh of minute pulmonary vessels in which the aëration of the blood is effected. The worm, the naïs, and others are setigerous, but the leech and its allies are smooth, and destitute of minute bristles.

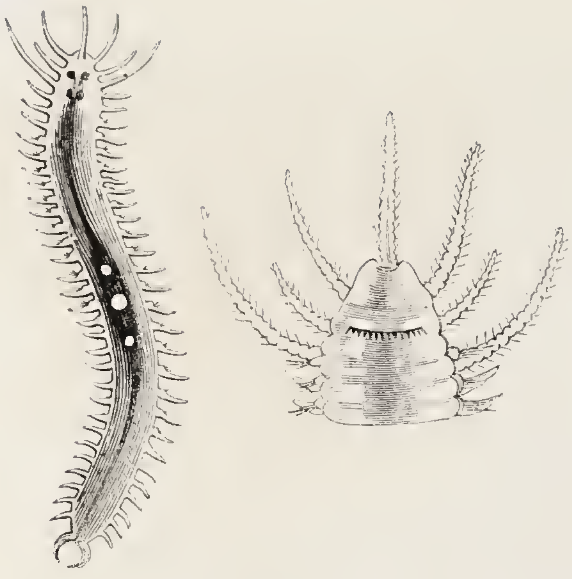
The Dorsibranchiate Annelides are all marine: and of these the lug-worm (Arenicola piscatorum), used as a bait by fishermen, is a familiar example. It lives in the sand of low flat shores, and attains to about a foot in length; it is of a reddish colour, and gives out a yellow fluid secretion which stains the hand. The secreting organs of the Dorsbranchiata consist of vascular tufts or fringes, or fleshy crests, of which sometimes a pair are affixed to every segment, as in Leodice antennata, or only on the middle segments, as in Arenicola. Besides these respiratory appendages, there are others also of variable form and number, serving the purpose of locomotion; sometimes these resemble the jointed limbs of the Myriapodes, but are retractile to a greater or less extent; sometimes they consist of setæ or spines. In the sea mouse (Aphrodita aculeata) found on our coast, the setæ are remarkably developed and glisten with the richest iridescence.

The sea-mouse (Aphrodita aculeata), Fig. 3758, is from five to seven inches in length, of an oblong depressed figure. Its upper surface is covered by a double row of broad membranous plates overlapping each other, beneath which are the aërating gills, like little fleshy crests. These plates are covered by a sort of hair which springs from their outer margin, and besides these the upper surface is beset with bundles of iridescent bristles, brilliant as the plumage of the humming-bird, and of which metallic blue, green, and gold are the predominating tints. Referring to Fig. 3758, a is the underneath view; b, a lateral view. In Nereïs, the branchiæ are in the form of little laminæ on which a network of vessels ramifies; the head is furnished with tentacular cirrhi; and tufts of bristles, as well as tentacular limbs, spring from each segment of the body. Fig. 3759 shows the Nereïs (Syllis) phosphorescens, a luminous species: a, the animal; b, a magnified view of the head. The mouth of the Dorsibranchiate Annelides is very remarkable, and consists of a muscular proboscis, retracted when not in use, and capable of being everted like the finger of a glove; in this manner protrusion is effected. In some this proboscis is armed with sharp teeth, in others there are none; in Arenicola it is roughened with conical papillæ.

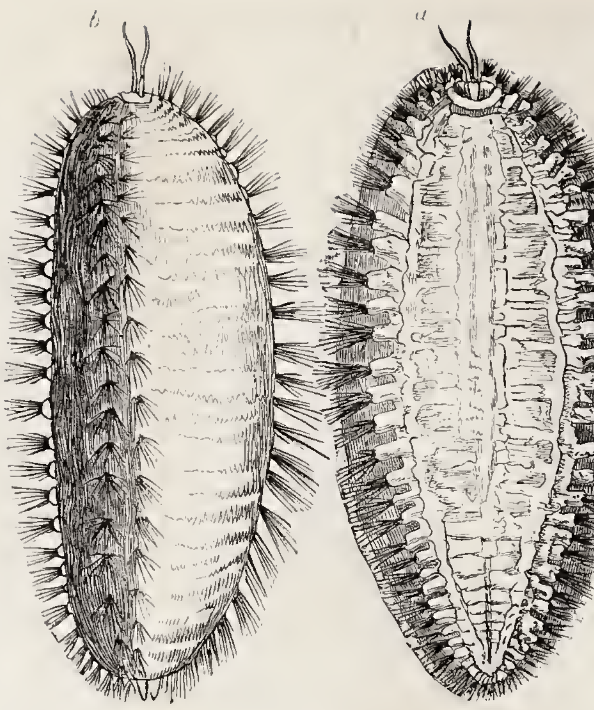
The Tubicolæ, instead of being free and wandering for food, inhabit fixed residences, which serve at once as a domicile and protection. They tenant tubes of their own formation, but of varying materials according to the species: in no instance is there any muscular connection between the annelide and its case. Specimens of the Serpula contortuplicata are not uncommon in cabinets, and the species is found on our shores; as is also a smaller species, S. vermicularis. The tubes of these Serpulæ are generally intertwined with each other, and with old shells and pebbles; indeed they often wind over shells or stones, and are cemented to them. Fig. 3760 shows the Serpula contortuplicata. Fig. 3761, Vermilia triquetra, of which the carinated tube is fixed by its whole length.

From the orifices of the tubes in which these annelides live, they protrude the anterior part of the body, in which the respiratory tufts are seated; and often also tentacular cirrhi. In Terebella the tentacles are filiform, and capable of considerable extension; the respiratory organs form tufts on each side of the neck.

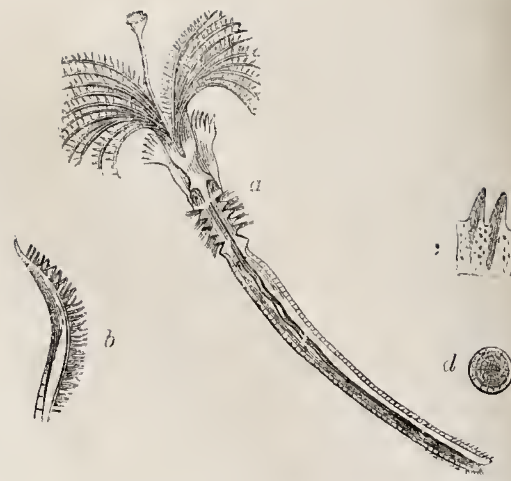
In the Serpulidæ there are two singular appendages, of which one, the right or left indifferently, is greatly enlarged, so as to form a stopper to the mouth of the tube when the animal is withdrawn within it. See Fig. 3760. In this group the respiratory organs resemble two fan-like plumes of exquisite delicacy and splendour. In Serpula contortuplicata they are of a fine red, varied with orange and violet; in S. vermicularis of a rich blue. When



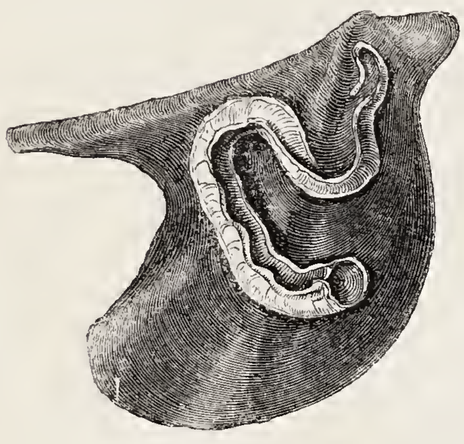
3759.—Nereis phosphorescens



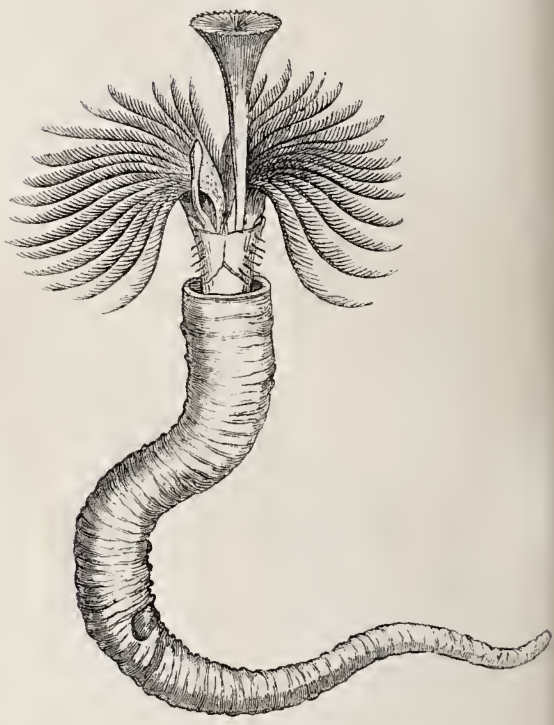
3758.—Sea-Mouse.



3762.—Ditrupa subulata.



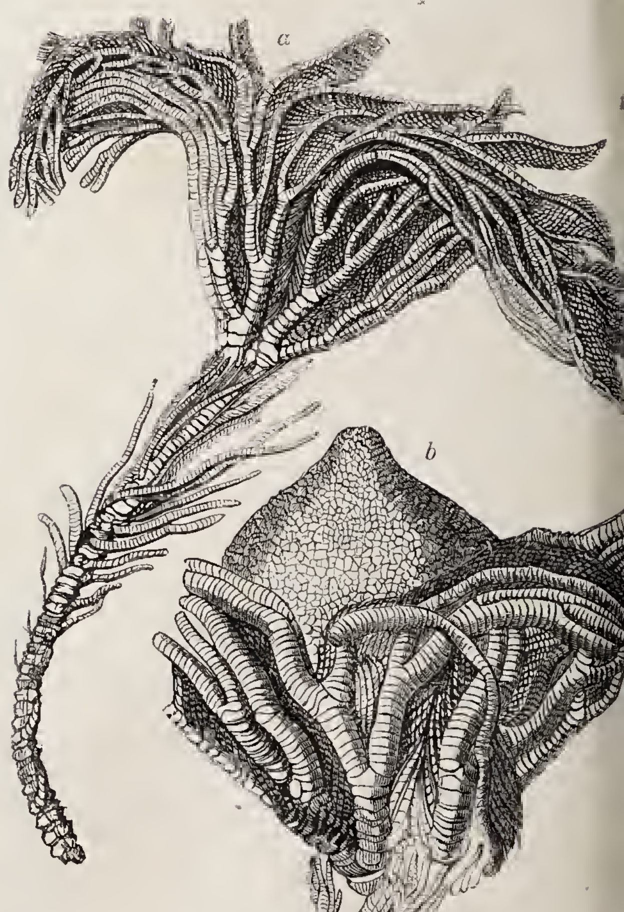
3761.—Vermilia triquetra.



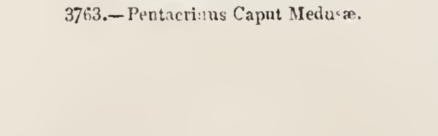
3760.—Serpula contortuplicata.

3763.—Pentacrinus Caput Medusæ.

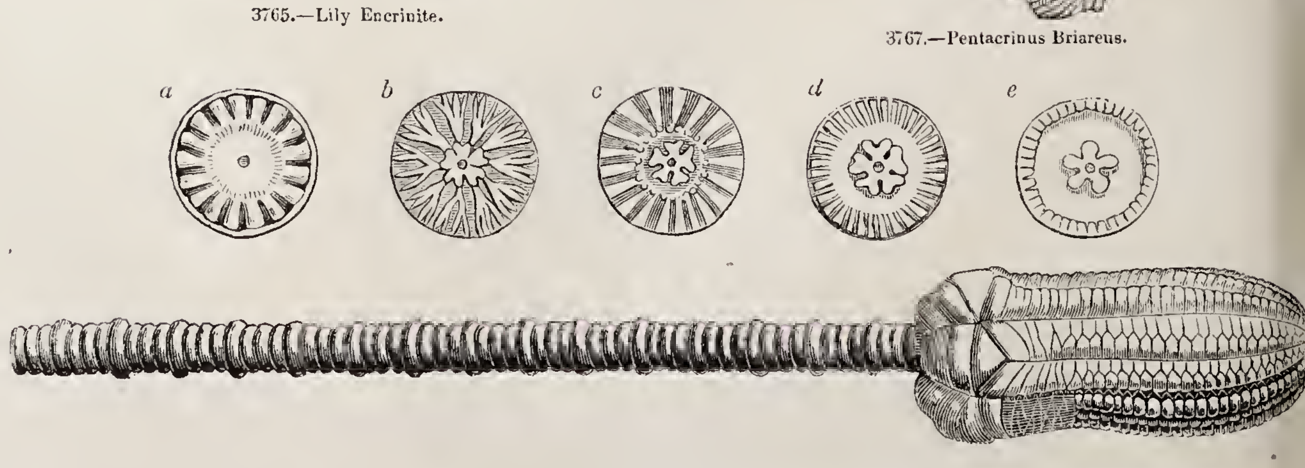
3765.—Lily Encrinite.



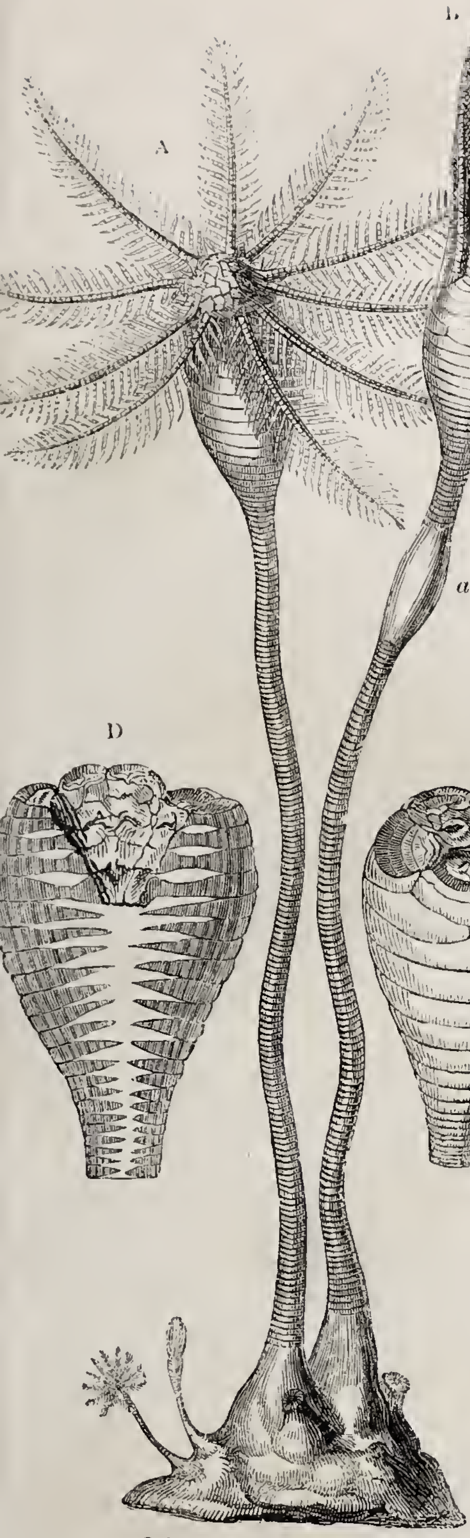
3767.—Pentacrinus Briareus.



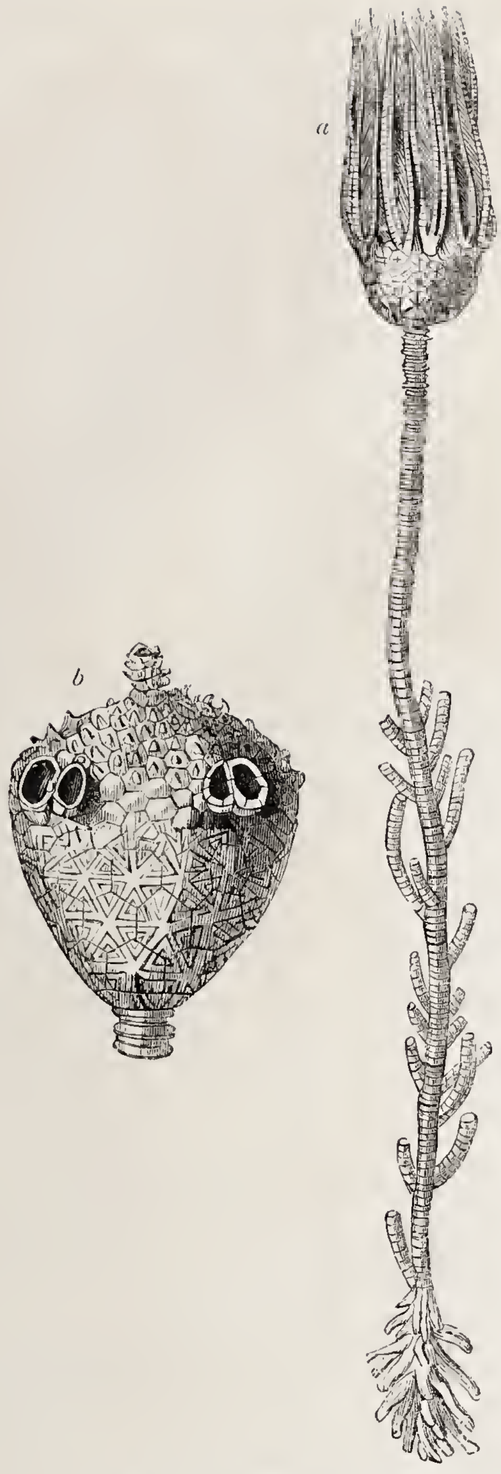
3764.—Pentacrinus Europæus.



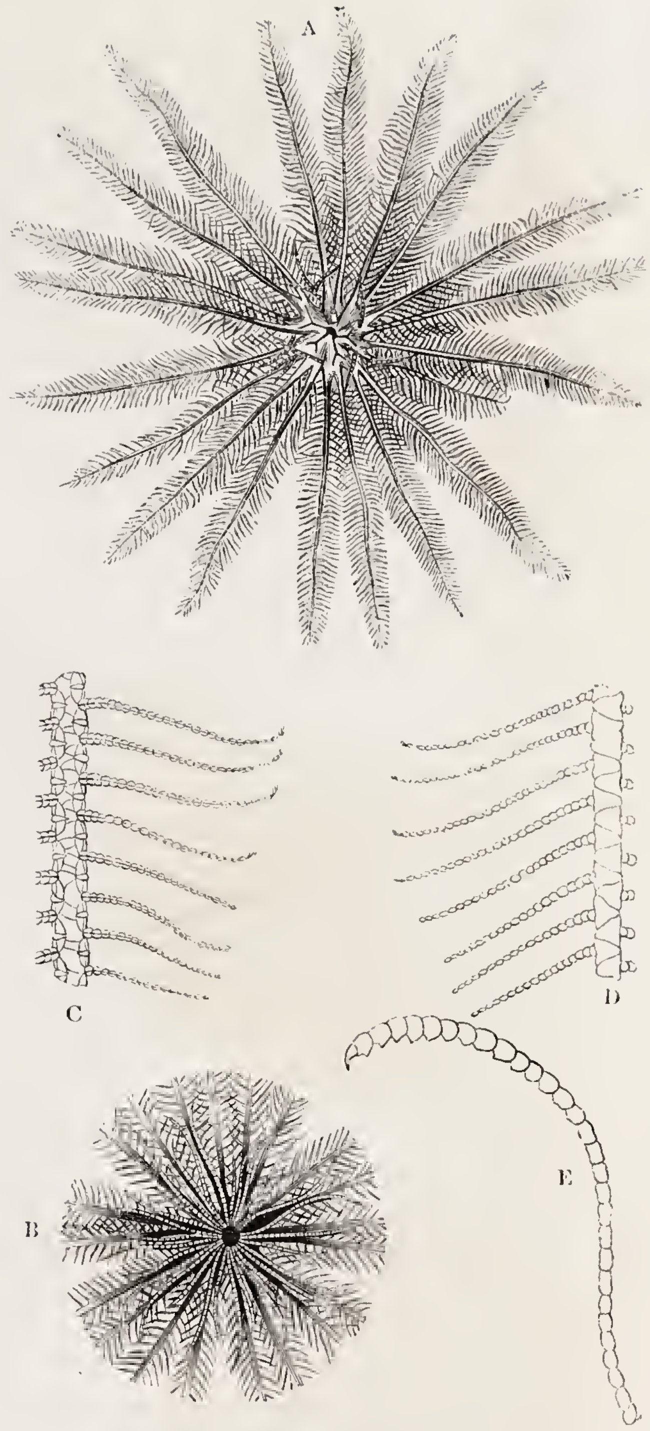
3766.—Lily Encrinite.



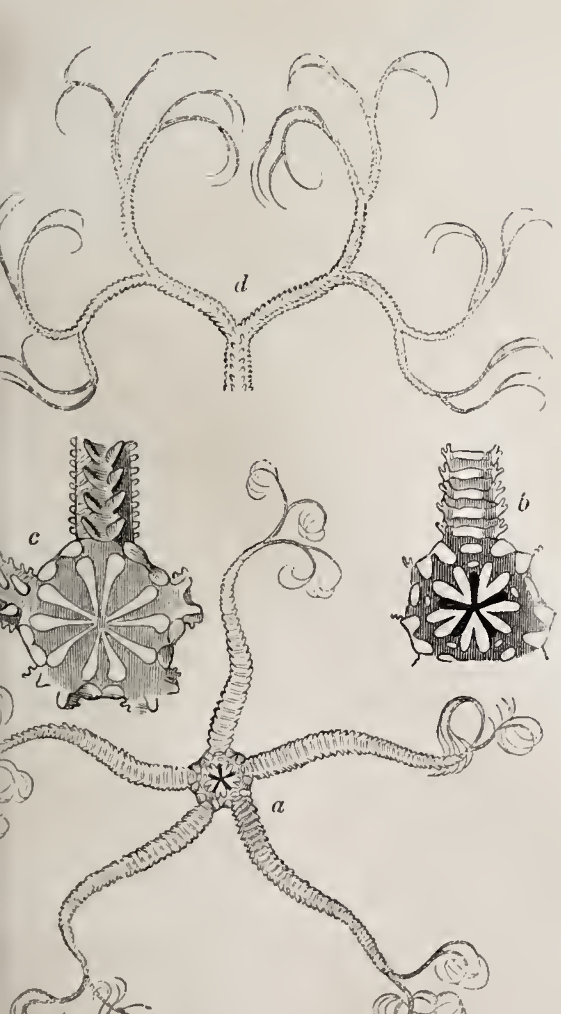
3768.—Apiocrinites rotundas.



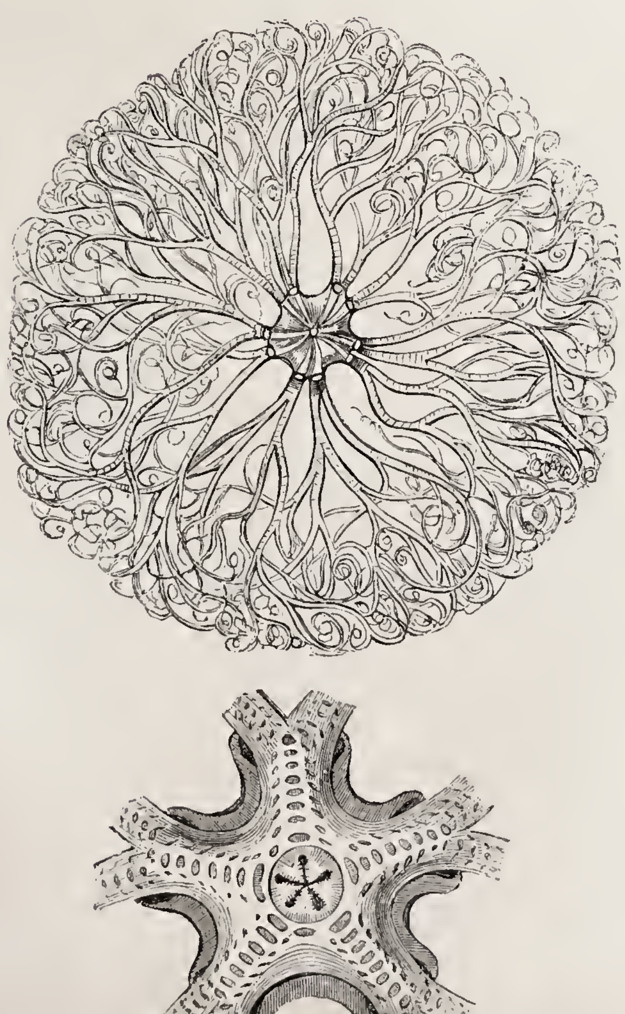
3769.—Actinocrinites Triacontadactylus.



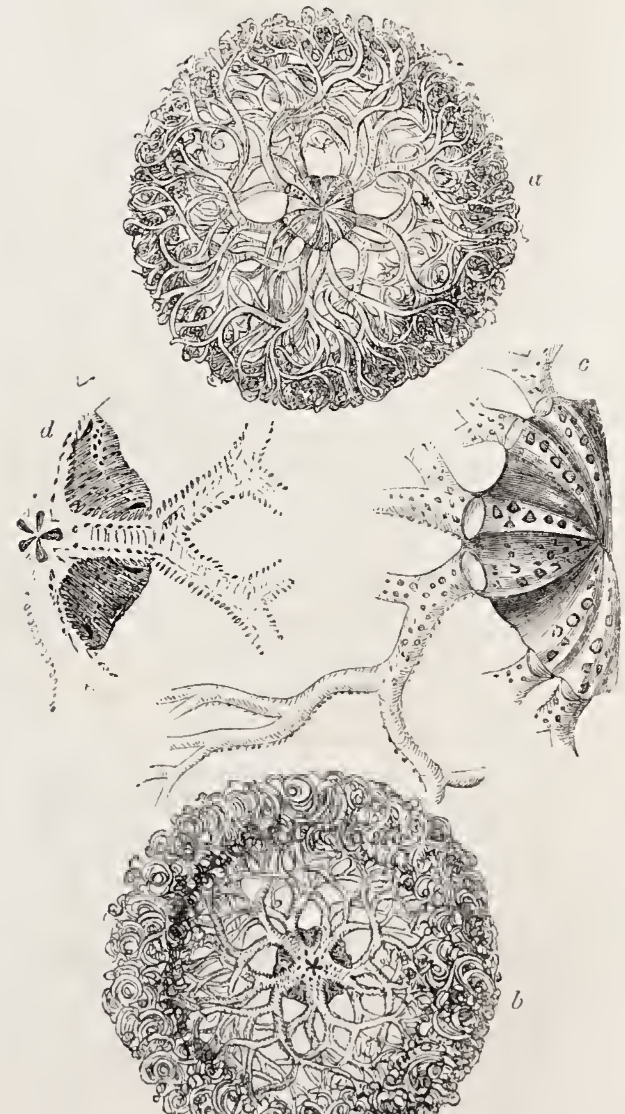
3770.—Comatula Adonæ.



3773.—Euryale palmifera.



3772.—Euryale costosa.



3771.—Euryale scutata.

fully expanded and in motion, they afford a beautiful spectacle.

Fig. 3762 represents the Ditrupa subulata, allied to Serpula; but differing in having its tube free and unattached to other objects; the tube moreover has an aperture at its posterior apex. From these circumstances the Ditrupa has been confounded with the molluscous dentalium, and it is to Mr. Berkeley (Zool. Journ.) that we owe our knowledge of its real affinities. It is found in fine sand at great depths in the British Seas, from sixty-four to one hundred and seventy-one fathoms. *a*, the animal out of its tube; *b*, one of the branchiæ; *c*, a portion of the anterior part of the mantle: *d*, the surface of the operculum or stopper. We may add that this species, the Dentalium subulatum of Deshayes, occurs also around the shores of Madeira. The Terebellæ inhabit sandy shores half way between high and low water, buried up to the orifice of their tube in the sand. As the bed is liable to shift from the action of the waves, these annelides are sometimes covered deeply, and at other times exposed. In the former case the animal works its way to the surface elongating its tube as it proceeds; in the latter it must bury itself deep and yet continue its tube; in these operations its tentacles are of great importance. If one of the Terebellæ be deprived of its sand-tube, and placed in a vessel of sea-water with a bed of sea-sand and fragments of shells at the bottom, it may be seen expanding its tentacles to the extent of nearly two inches, and dragging by their means particles of all sorts towards its head; with these it forms a ring round its neck cementing them together by a glutinous secretion. During its labours it keeps bending the head from side to side, adding to the collar, and pushing up its body as it proceeds. Having formed a collar of about an inch broad, it begins to burrow, and directing its head against the sand, slowly makes its way, availing itself of every fit particle to add to the tube—so far the head is downwards. Now, however, the tube being completed and fixed in the sand, the annelide emerges from it, and re-entering tail foremost, keeps its head uppermost, thus reversing its position, in order that the branchiæ may be exposed to the water, and the tentacles employed in quest of food. Thus the tube is buried in the sand, with a small portion only above the surface. This process during summer requires about five hours, but a longer time in winter, the animal being less vigorous.

The annelida, as far as we know, are oviparous; in the common earth-worm the eggs are about three lines long, and somewhat oval; they contain each two yolks, a pair of young springing from every egg; these eggs have a sort of lid at each end, which opens when the worms are mature to permit their exit.

With respect to the leach, a naked suctorial annelid, we may observe that not only is it furnished with a caudal disc, but the anterior extremity is capable of being used as a prehensile sucker. In the centre of this oral sucker are three diminutive but sharp teeth, and near the anterior margin (in the medicinal leech) are ten very minute black eyes, ranged in a crescentic manner, and probably adapted only for very close vision. This facility, however, is in all probability at a low ratio.

Like the worm, the leech produces capsular eggs. Some species in Chili and Ceylon are terrestrial, living in woods, where they crawl upon the leaves and branches of shrubs, and the trunks of trees; and a European species, Geobdella trochetii, lives as much on land as in the water. The ordinary food of leeches appears to consists of minute animals, as tadpoles, aquatic worms and larvæ, and decomposed animal matters. The leech-fishers of La Brenne place bits of decayed flesh in the water, round which these creatures crowd in shoals, and, intent upon their food, are then easily captured. We must pass, however, from this last class of the Homogangliata, to another subkingdom.

SUBKINGDOM NEMATONEURA.

THE groups comprehended in the present division of the animal kingdom, though agreeing in certain structural points, differ materially from each other in general economy and external characters, insomuch that many seem to belong rather to the acritous subkingdom than to the present, in which the nerves are apparent in the form of threads diversely arranged. We allude particularly to the Cœlemintha, or cavitary intestinal worms; the Bryozoa, or moss corals, and the microscopic Rotifera. Yet have these characters which elevate them above the nerveless groups, both as respects structure and reproduction. We must not, however, enter into anatomical minutiæ.

CLASS ECHINODERMATA

(ECHINI, OR SEA-URCHINS; ASTERIAS, OR SEA-STARS, &c.). The Echinodermata are so called from the hedgehog-like spines with which certain species are covered: the title however is but partially applieable; indeed this class presents us with a series of forms so modified by progressive transitions of character, that were we to be shown an Encrinite, an Echinus, and a species of Holothuria or Fistularia, we might be pardoned for questioning the affinity that is proved to exist between them. Nevertheless, if we commence with the encrinite, in which a radiated body is supported on a long stem, we shall find that by progressive steps we may advance through comatula, Euryale, Ophiura, and others to asterias, and thence through Scutella and others to Echinus. These have all a tesselated calcareous covering, but in the Holothuria we find a decided approach towards the annelides. The calcareous covering is changed for a tough but irritable integument, a few thin calcareous laminæ surrounding the mouth being the vestiges of the shell developed to its maximum in the Echinus. Leaving these general views, let us attend to the various leading forms of which the present class consists: and first the Encrinite.

The Encrinite belongs to the crinoid or lily-like family of the Echinodermata, and is essentially a tenant of the hotter seas. One minute species (Pentacrinus Europæus), has been detected in the seas of Europe attached to corals; but the tropical ocean presents us with species of large size, and most elegant appearance; they are, however, extremely rare, and few cabinets can boast of a specimen. Most probably the long tesselated peduncle of these creatures is attached to solid rocks or submarine bodies at great depths, below the influence of the turbulent waves; there they twist about, and spread their fringed arms in quest of prey, or clasp the rock for additional security. There is a specimen of the Pentacrinus Caput Medusæ in the British Museum, in that of the Royal College of Surgeons, and in that of the Geological Society. It is a most beautiful species, and exists in the seas of the Antilles.

Fig. 3763 represents the upper part or head of Pentacrinus Caput Medusæ. In the front two of the arms are much smaller than the others, showing that the animal had suffered mutilation, and that the lost parts had been reproduced, though not fully developed: *a*, the auxiliary side arms, articulating at distant intervals, with the jointed column, and also capable of being reproduced.

Fig. 3764 represents the Pentacrinus Europæus: *a*, several individuals in different stages of development, adhering by the base of their jointed column to the stem of a coralline; *b*, one of the individuals expanded and magnified. According to Mr. Thompson, this minute species, found on the coast of Ireland, is fixed by its stem to other bodies only in early life; he believes that it is in fact a comatula, and that in due time it becomes detached, loses its stem, and moves freely at the bottom of the water, creeping among the fronds of sea-weed. ('Proceeds. Royal Soc.' 1835.)

The rarity of the encrinite in the seas of the present world is very singular, when we call to mind the multitude of fossil species, and find whole masses of rock consisting of their reliquia. At a distant epoch of this planet, when its surface was very different from what now obtains, and a high temperature favoured the increase of beings the rare analogies of which now exist only in the intertropics, encrinites thronged the sea, from which our older calcareous rocks were deposited. In Derbyshire we find immense strata of Encrinite or Entrochite marble, replete with the exuviæ of the creatures which had lived and died, generation after generation, through a long succession of ages, in the spots where the geologist now collects them. The broken joints of these entrochites are called St. Cuthbert's beads: they resemble small and nearly solid wheels, with a cinque-foil orifice in the centre. When the outer coat of these fossil encrinites is destroyed, the central part or stipe, in which was the living animal, of ligamentous texture, presents a series of circular equidistant plates round a tubular axis. These relics are called screw-stones. To some of the splendid fossil forms of this family we would invite a moment's attention. Fig. 3765 represents the Lily Encrinite (Encrinus liliiformis), or Stone lily of the English; its remains occur in the Muschel-kalk of Germany, at Hildesheim, Rakenberg, &c., in Lower Saxony, at Scwerven in Westphalia, and the village of Erkerode in Brunswick. Fig. 3766 represents another specimen; *a b c d* and *e*, different joints of which the stem is composed.

Fig. 3767 represents the Pentacrinus Briareus. This rare and beautiful species occurs in the lias and other strata of the oolite series, at Lyme, Watchet, Keynsham, &c.:—*a* shows the head and arms reduced; *b*, the upper part of the natural size, with the arms entwined around the plated integument of the abdominal cavity, which terminates above by a sort of proboscis.

The Encrinites may be defined as comatulæ, with the disc prolonged into a stem, and divided into numerous articulations, every part being strengthened by a mosaic of calcareous pieces, imbedded in the living matter of which the animal consists: each single articulation is thus tesselated, the separate portions being kept in juxtaposition by the living body. The disc or centre from which the arms radiate is also composed of several plates fitted to each other. Of the internal structure of the encrinite little is known; there is an injestive and and an ejestive orifice, as in Comatula, and it is probable that there is a gastric cavity with an alimentary canal convoluted around it.

Both in Encrinus and Comatula the rays are beset on each side with a row of firm jointed filaments, adapting them admirably for the tenacious grasp of their prey. In Comatula, which is free, they also serve as locomotive organs, enabling the animal to crawl along the sandy bed of the ocean.

To the extinct fossil forms of Encrinite belongs the Apiocrinites rotundus, found in the middle regions of the oolitic series, and which is represented restored (and reduced) at Fig. 3768. A, shows the arms expanded; B, the same closed; *a*, the remedial effect of calcareous secretions in repairing an injury of the joints of the stem; at the base of these are two young individuals, and two truncated stems; C, the pear-shaped body divested of its arms; D, a vertical section of the body, showing the cavity of the stomach, and a series of lower cavities or hollow lenticular spaces continued down the stem; these cavities are the moulds in which the screw-stones are formed. Another form, Actinocrinites Triacontadactylus (the Nave Encrinite of Parkinson), from the mountain limestone, is represented at Fig. 3769 (reduced): *a*, the body and stem; *b*, the body divested of the arms. There are numerous other fossil forms, the types of distinct genera.

From the Encrinites let us pass to the sea-stars or Stelleridæ, of which, as we have said, the form nearest to the previous group is represented by Comatula. Fig. 3770 shows Comatula Adonæ, from the seas of New Holland. It is encircled by ten slender rays or arms, fringed with jointed filaments: A shows the animal three-fourths the natural size, under side; B, the same, upper side; C, a portion of one of the arms, with its fringe, magnified, under side; D, the same, under side; E, one of the rays enlarged, showing the terminal hook or anchor.

From this form we may proceed to Euryale (Gorgonocephalus, Leach). Fig. 3771 represents the Euryale scutata from the Indian seas: *a*, the back; *b*, the front; *c*, a portion of the back; *d*, the same, front, natural size. Fig. 3772, Euryale costosa: *a*, the centre, front view, natural size. This species is from the American seas. Here we begin to trace a development of the central disc. The arms are not fringed, but most multitudinously branched, the ramifications forming a network, in which prey is enclosed and secured. In another species, however, Euryale palmifera, the ramifications are less numerous and terminal only. Fig. 3773 shows, *a*, Euryale palmifera, front view; *b*, the disc and part of arm, front view, natural size; *c*, the same, back view; *d*, extremity of one arm, natural size. Passing from these we find in the Ophiuræ a disc surrounded by five slender arms, like the tail of a snake, squamous, and unfurrowed beneath. Fig. 3774 represents Ophiura texturata of the European seas: *a*, the front; *b*, the back; *c*, a portion of centre and arm, magnified, front; *d*, the same, back. Fig. 3775, Ophiura annulosa from the Australian seas: the back; *a*, a portion of one arm, under surface, magnified; *b*, the same, upper side; *c*, front view of centre. Fig. 3776, Ophiura granulata of the European seas and the Atlantic generally: *a*, front; *b*, back; *c*, portion of arm, back view, natural size; *d*, the same, front view. The Ophiuræ are active, and swim and creep with much facility in all directions, agitating the arms in a serpent-like manner.

We may now advance to the true sea-stars, Asterias, of which one tribe is radiated, having five arms; of this the star-fish (Asterias rubens), so common on our coasts, is an example. The other tribe consists of the scutellated star-fish, or sea-stars, in which the arms are short, often forming five acute angles to an expanded body. Of this group the Asterias tessellata, Fig. 3777, may be selected as an example: it is widely distributed.

And here, before passing to the Echinidæ, we may devote a short space to the general structure of these animals, taking the well-known sea-star of our coast as an example. As we have said, it presents a disc and five rays. The external integument is horny or coriaceous, with calcareous portions thickly interspersed through its substance, forming spines and tubercles on its surface. Along the front or under surface of the rays, and around the mouth, there are rows of distinct moveable spines; but on the back or upper surface they are in the form of close-set conical eminences. This coriaceous, but still flexible integument is tinted in various species with different colours: in the common star-fish the

pigment is reddish, and of a caustic quality, producing irritation on the hands of persons roughly handling the living animal. The integument, coriaceous as it is, is evidently sensitive; it shrinks on the application of the knife, and the rays bend and twist about in various directions. These motions depend on muscular fibres or bands extending along the rays from the central disc. Besides the spines and tubercles, the skin of the star-fish presents numerous minute polype-like processes, each having a bifid or trifid point. They are termed pedicellariæ, and as they apply themselves to minute bodies in contact with them, they have been regarded by some as organs of prehension, but by others as distinct microscopic animalcules; the latter theory is now abandoned, and the former is untenable, inasmuch as the extreme delicacy of these organs ill adapts them for seizing or retaining with any degree of power. We are inclined to think them organs of tact.

In the Ophiuræ the calcareous plates and portions are soldered and form a sort of box; in other instances they are conjoined by ligament; in the common star-fish they form tubercles.

If we look at the under surface of an Asterias we shall perceive along each ray a calcareous framework, composed of regular and distinct portions, fitted to each other and united by ligament so as to represent, in a slight degree, the vertebral column of a quadruped. This arrangement commences at the mouth, which is surrounded by a circular framework of the same character, and extends in a furrow down each ray. This furrow is termed the ambulacrum, or ambulacral groove. The mode in which the plates of the ambulacrum are joined together is so contrived as to leave apertures, termed ambulacral orifices, between each pair of plates, in regular order. Through these orifices are protruded small fleshy stems, each terminating in a sucking disc. They are at once the principal organs of locomotion, and of securing the prey enfolded in the rays. The manner in which these suckers are protruded and withdrawn is very curious and yet simple. They are muscular and hollow, and communicate with sacs or reservoirs of fluid; the walls of these sacs are muscular and contractile. When the animal wishes to protrude its suckers, it contracts the sacs within the rays, so as to force the fluid into the hollow stems of the suckers, which, being distended, emerge through the ambulacral orifices; on the contrary, when the sacs are dilated, the fluid returns, leaving the tubes of the suckers, the stems at the same time contracting and retiring within their respective apertures. The fluid which these sacs contain is supplied by a system of vessels, asserted by some to be part of the vascular apparatus, but by others to be totally unconnected with it. The latter is the opinion of Professor Tiedemann, who, with Professor Sharpey, regards the sacs of the suckers as containing simple sea-water. The mouth of the Asterias is seated on the under surface of the central disc; the calcareous portions surrounding it give firmness, and assist in the retention of food. It leads to a capacious gullet, and this into a large sacculated stomach, which, instead of being confined to the disc, is carried out by means of curiously convoluted tubes through the extent of the rays. These tubes are plaited on a delicate membrane which both lines the external investment of the animal and is reflected over all the internal organs. Each ray contains two of these prolongated convolutions of the stomach, the nature and use of which do not appear to be clearly understood. Perhaps they are intended for the absorption of the nutritive particles of the food, which may be taken up by a system of veins distributed like a fine net-work over them throughout their course. They do not exist in the Ophiuræ, in which the stomach is plicated. At the base of the stomach a biliary sac is placed, opening at the former by a duct. With respect to the sanguiferous system, we may observe that the veins collect into a large circular vessel sweeping round the circumference of the central disc; and this communicates by means of a dilated vessel of muscular structure and great irritability with a small circular vessel running round the mouth, and which is generally regarded as arterial in its functions, the dilated channel being analogous to the heart. From this smaller circle five tubes supply the viscera; moreover, there are appended to it, at regular intervals, certain oval vesicles containing a fluid of a pale reddish tint: their use is not very apparent. We must not here omit to notice a singular tube which runs in conjunction with the vessel or communication (or heart) between the two circles, and is enclosed in the same sheath. This tube, which is called the sand-canal, enters the circular oval vessel by one extremity, and appears to communicate by its opposite end with a calcareous nodule on the dorsal surface of the disc. It is composed of a series of calcareous rings: internally it contains two convoluted calcareous laminæ which blend into the dorsal surface. Of the use of this tube nothing is definitely known.

The aëration of the circulating fluids in Asterias is effected by a free admission of water into the general cavity of the animal through multifarious pores on the outer surface, bathing the viscera and the peritoneal lining. This membrane is covered with multitudes of minute cilia, and similar ciliæ are distributed over the cavities of the suckers and the inside of the digestive apparatus. They are in continual motion, and act, it is presumed, in aërating the blood, by keeping up a continual current in the water absorbed, so that every part may be washed with a fresh and unexhausted portion. The nervous system consists of a ring round the mouth, giving off filaments to the rays and viscera. The sense of touch is, in fact, very delicate in these creatures, though, there being no sensorium to which sensations may be referred, severe wounds are endured without any positive manifestation of suffering. Yet the animal not only recognises its prey, when in close contact, but seems aware of its presence, and is attracted towards it, even at some distance. This is not more wonderful than that the Hydra, which may be cut asunder without injury, should feel the light of the sun. Ehrenberg asserts that eyes may be detected in some species, at the ends of the rays, in the form of little red dots: this, to say the least, is very problematical.

With respect to the habits and manners of the star-fish, we may observe that they are such as may may be expected from carnivorous animals. These animals are among the scavengers of the sea; they devour putrescent animal substances, and make shell-fish, crustacea, and fishes their prey. They are extremely voracious, and though apparently inert, are capable of overpowering the struggles of the most active of their victims. When watching for their prey they rest with the rays gently bent towards the mouth; the instant that a shell-fish or unlucky crab comes within their grasp, they fold themselves closely over it, the rays pressing it to the mouth, which is dilated to receive it: still it might be supposed capable of escaping by the exertion of strength and activity; not so, for no sooner do the rays fold over it, than all the suckers, to the amount of more than three hundred in each ray, are protruded and fixed tenaciously upon it. Its efforts are in vain, and, struggle as it may, it is dragged closer and closer, and at length engulfed. In a short time the soft parts of the prey are dissolved, the hard and shelly portions being rejected. Small crabs and small shell-fish are swallowed entire, for the stomach is amazingly dilatable; but shell-fish of large size are not the less the victims of the Asterias, though it cannot swallow them whole. The destruction which it commits among oysters was indeed well known to the ancients, who believed that it obtained the mollusk by inserting one of its rays between the valves of the shell when the creature happened to lie with them partially open, and that it then gradually forced itself in, till its prey became in contact with its mouth.

> "Sic struit insidias, sic, subdola, fraudes
> Stella Marina parat, sed nullo adjuta lapillo
> Nititur,—et pedibus scabris disjungit hiantes."
>
> OPPIAN.

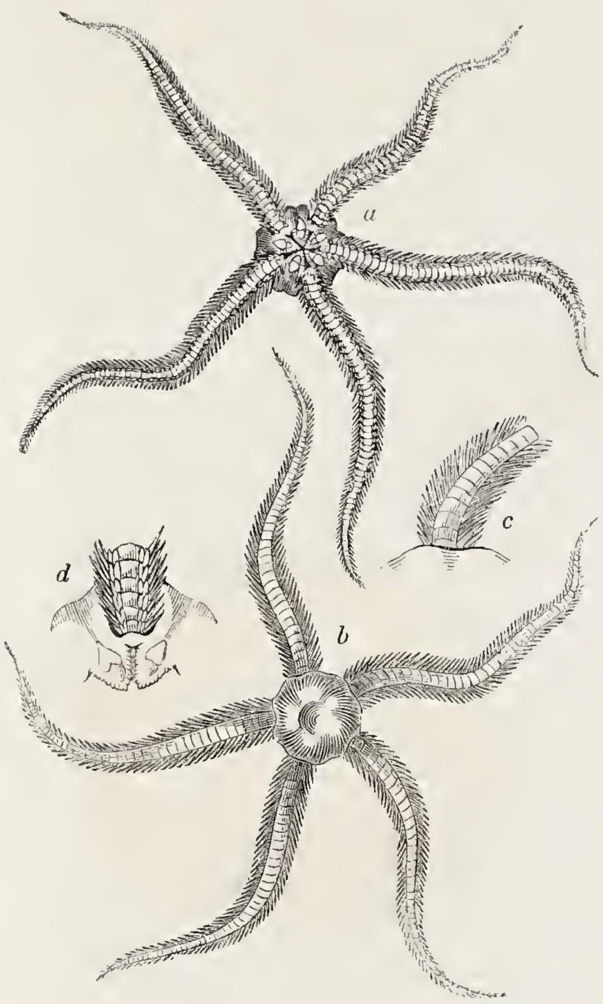
That the Asterias destroys shell-fish is unquestionable, but it certainly does not proceed in the mode supposed by the ancients. Some degree of light on this point has been the result of certain observations by M. Deslongchamps. On one occasion, when the tide had ebbed, leaving only a few inches' depth of water on a sandy beach, he saw considerable numbers of star-fish rolling about in compact balls, five or six being fastened together by the interlacing of their arms. On proceeding to examine these balls he found them enclosing each a large bivalve mollusk (Mactra stultorum). The valves of the shell were partially open, and round their edges was ranged the mouth of each star-fish; while between the valves were introduced large rounded vesicles of a thin membranous texture, filled with a transparent fluid. On examining these vesicles more attentively, it was found that they were five in number, two as large as filberts, three not much larger than peas, and arose by peduncles from the disc of the star-fish. From an orifice in each vesicle the contained fluid oozed drop by drop. When the star-fish were removed from their prey, these vesicles collapsed, and became no longer visible. The query is, what were these vesicles? why were they introduced into the shell, and how did they escape injury? The probability appears to be that they contained a poisonous secretion, by which the vital energies of the mollusk were destroyed, and that they were insinuated by degrees, as the mollusk, clasped in the arms of its destroyers, and absorbing some of the poison poured out upon the edges of the shell, became paralyzed, the adductor muscles losing first by degrees, then more rapidly, the power of contraction, death ultimately supervening.

That this is the way in which the process was accomplished seems the more probable from the circumstance that some of the Mactræ examined, though apparently little injured, were either dead or perfectly powerless. With respect to the vesicles seen by M. Deslongchamps, we are not aware that they have been noticed by other naturalists. The use of the suckers, both in securing prey and in progression, has been alluded to; by their action the animal glides over the surface or up the perpendicular sides of rocks, however smooth or slippery. In the performance of this operation the rays are extended to their utmost, the suckers are all protruded, and in their movements remind one of the limbs of a millipede. If one of these animals be placed in a glass of clear sea-water, the curious action of the suckers may be readily contemplated.

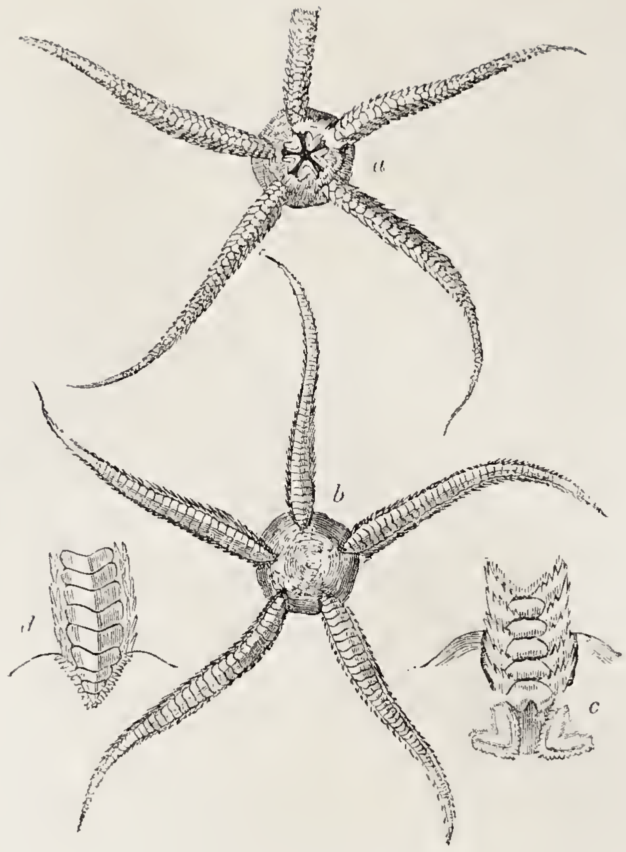
From the Stelleridæ let us now pass to the Echinidæ, of which the Spatangus, Fig. 3778, and the Echinus esculentus, Fig. 3779, are examples.

In Echinus, the typical form, we are presented with a subglobular box or crust, in which the animal is enclosed, and this box is invested with moveable spines. In order to examine the box, these spines (whence the animal derives the name of Sea-urchin) must be removed: we shall then find it to consist of numerous pieces accurately fitted together, their edges being adapted to each other, but not soldered. These pieces or plates consist of two kinds, differing from each other in size and form, as well as in the design they fulfil. First then, five broad rows of large pentagonal or hexagonal rows in pairs pass vertically down the sphere, forming a tessellated pavement; we say in pairs, because there are ten rows of these angular plates altogether, and each is studded with an elevated tubercle for the support of a spine. As the ordinary Echinus is globular or orange-shaped, these plates are largest around the meridian of the globe, and decrease as they approach the poles (to use figurative language), where are seated the injestive and ejestive orifices. Between these rows of tessellated double plates are ambulacral bands, composed of double rows of smaller plates, and pierced with foramina, which give exit to hundreds of long tubular suckers: now, besides these organs of progression, the spines of the Echinus, which differ in size, form, and number in the various species, are also appropriated to the same purpose. If we look at the tubercles on the large plates, we shall find each surmounted by a mammiliform apex, smooth and rounded. This little eminence has a pit in its centre. Now, if we take one of the spines and examine it, we shall find that the end which is fitted to the tubercle presents a cup-like socket, with a pit or little depression at the bottom. This socket fits the eminence surmounting the tubercle so as to form a ball-and-socket joint, and the attachment of the spine is secured by a ligament (ligamentum teres) which, fixed in the depression at the top of the eminence, runs into the pit at the bottom of the socket of the spine, thus securing it and allowing a free revolving motion. A muscular capsule surrounds this articulation, arising from the circumference of the tubercle, and inserted around the base of the spine; by this capsule the spine is rotated. It is by the action of these spines that the Echinus buries itself in the sand: those at the poles are shorter than those around the meridian, and while the rest are laid flat and kept motionless, the polar spines are revolved, so as to throw up the sand and make a depression, into which the animal sinks; as it sinks the spines of the meridian are brought into play, and then those around the mouth, the action of the last-used spines being to keep an aperture in the sand for the admission of water to the mouth. In moving from place to place the Echinus rolls along on its spines, aided by its suckers, and is even able to climb rocks in quest of shells and zoophytes. From the mobility of its spines and the length of its suckers it is much more locomotive than its appearance would at first lead one to imagine.

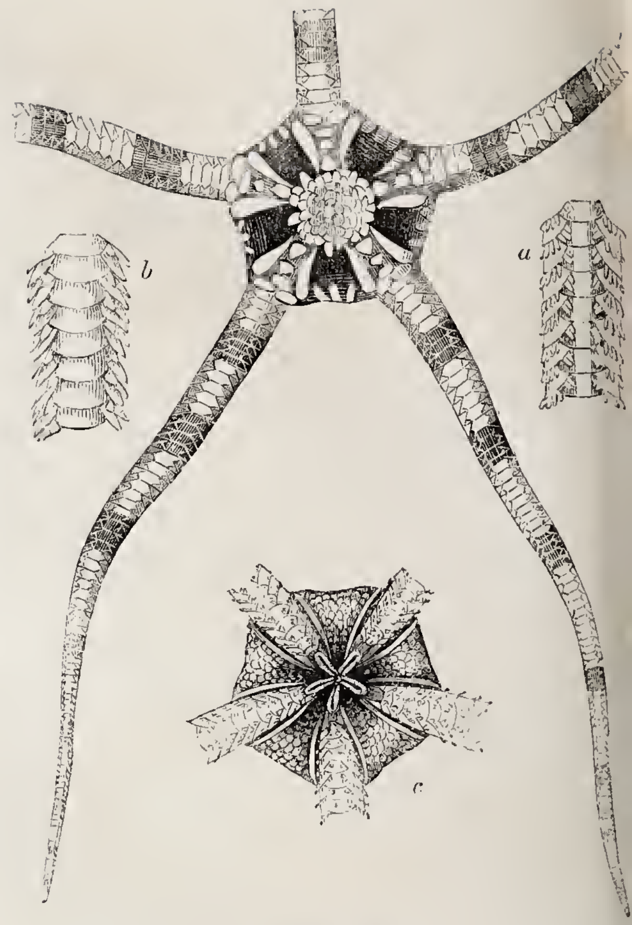
The growth of the calcareous shell and spines of the Echinus here demand notice. With respect to the shell, it is lined within by a delicate vascular membrane, which passes between the margins of each plate so as in reality to keep them distinct, and then covers the outer surface, being also continued over every spine. Not only the box then, but its separate parts and its spines are thus enclosed in a delicate skin: and to the edges of each separate part this secreting membrane adds particle by particle, at the same time that it thickens the increasing plates, and in this manner the whole enlarges without any alteration of form or relative proportions. The muscular capsule around the spines is only a portion of this general membranous investment, which, covering each spine as does a glove the fingers, secretes layer after layer of calcareous matter as it extends itself, and thus adds to the length and thickness of the enclosed appendage. Thus then the spines are formed by the addition of layer upon layer, and a longitudinal section of one will show the way in which the additions have been made. The



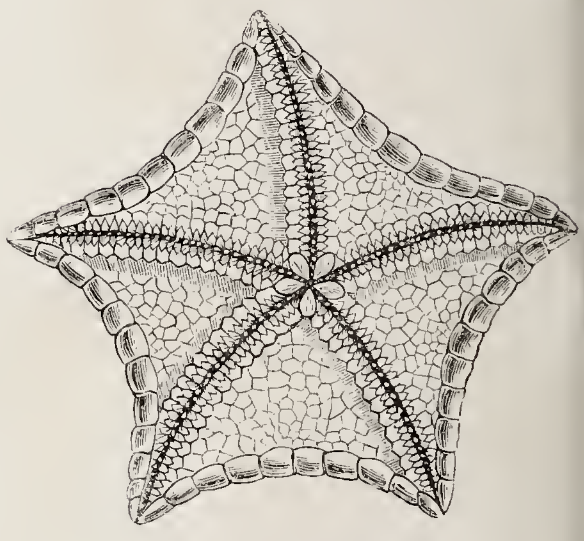
3776.—O, hiura granulata.



3774.—Ophiura texturata.



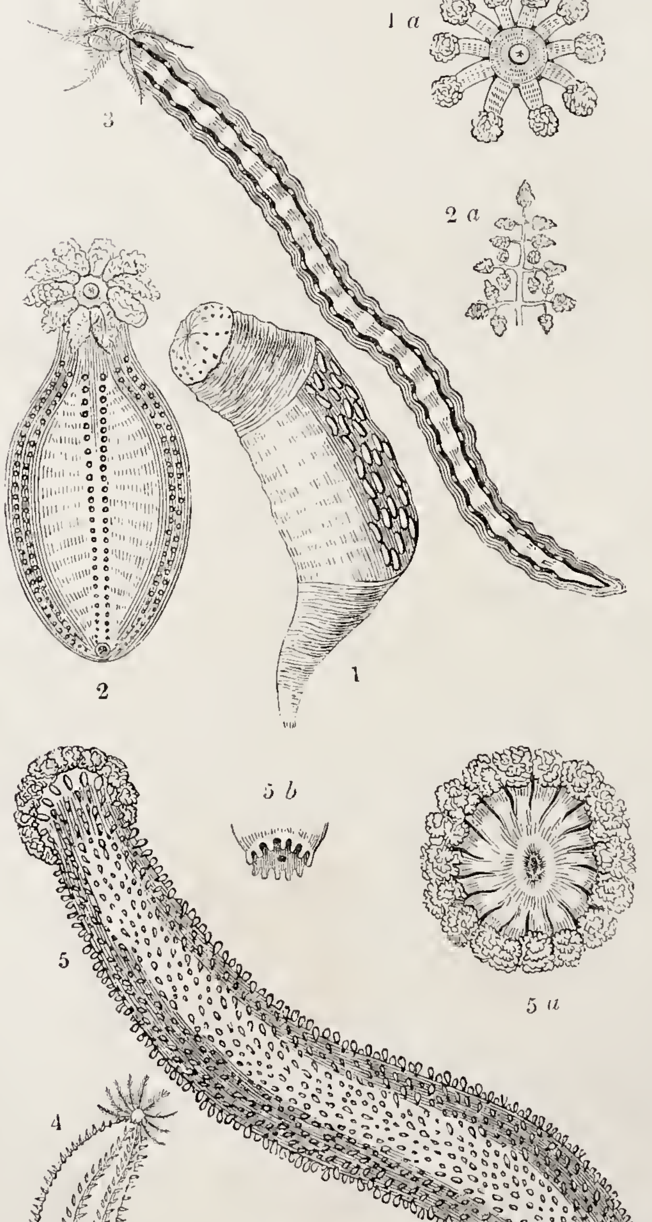
3775.—Ophiura annulosa.



3777.—Asterias tessellata.

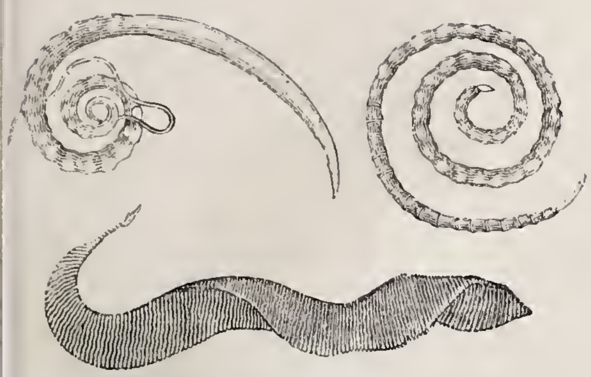
3778.—Sea-Egg.

3781.—Bonellia viridis.



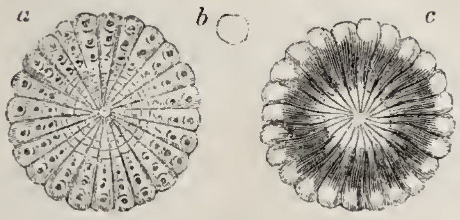
3780.—Holothuriæ.

3779.—Echinus esculentus.

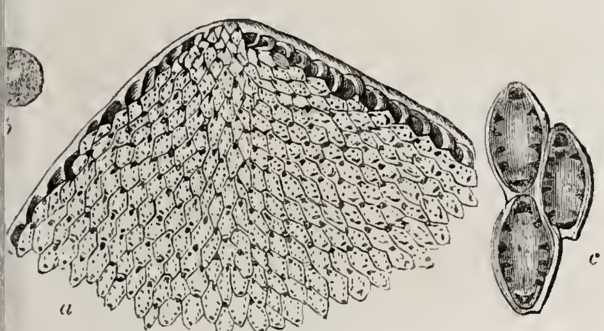


3782.—Intestinal Worms.

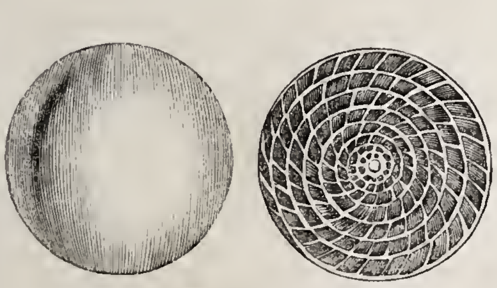
3783.—Strongylus equinus.



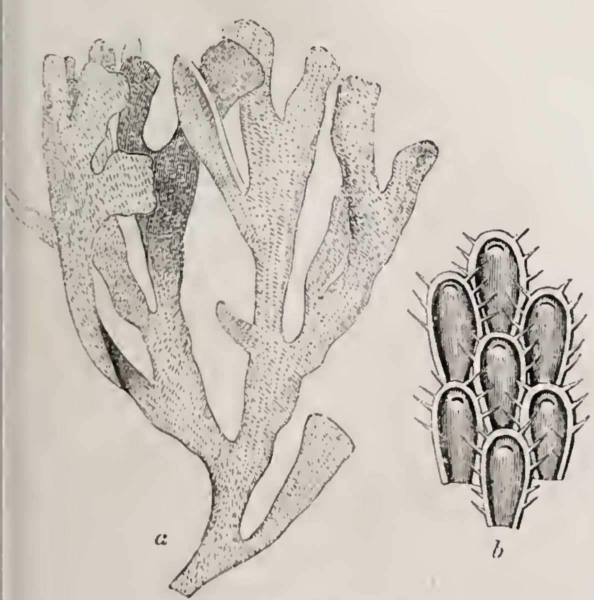
3787.—Lunulites radiata



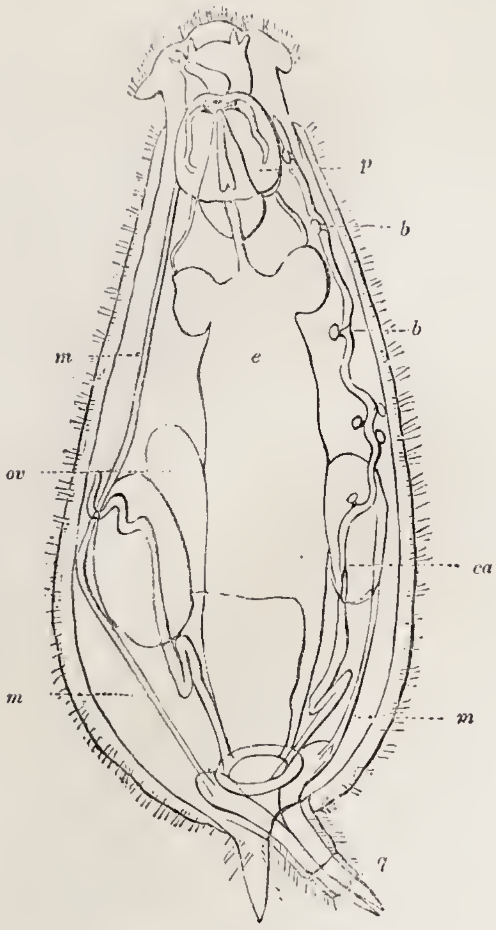
3788.—Lunulite en parasol.



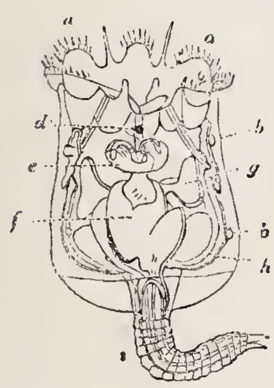
3789.—Nummulites lenticularis.



3790.—Flustra foliacea.



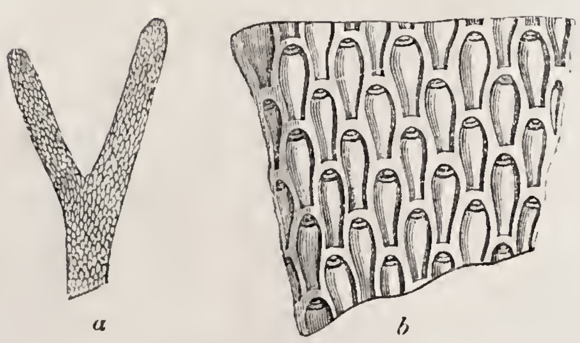
3786.—Notommata centrura.



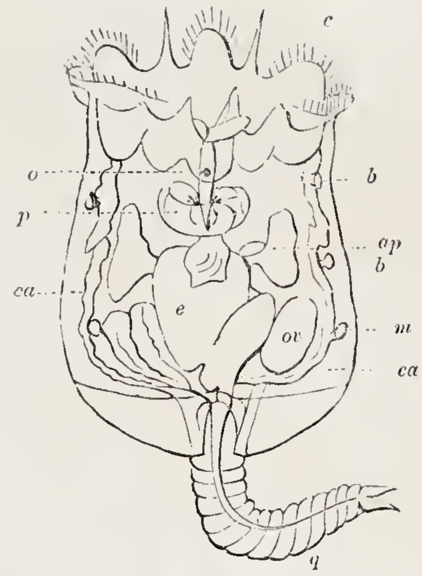
3784.—Brachionus urceolaris.

3798.—Cellaria ceroides.

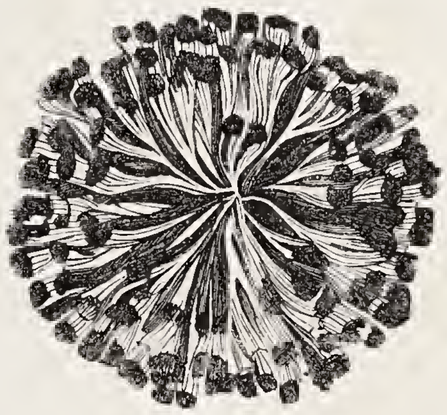
3795.—Electra verticella.



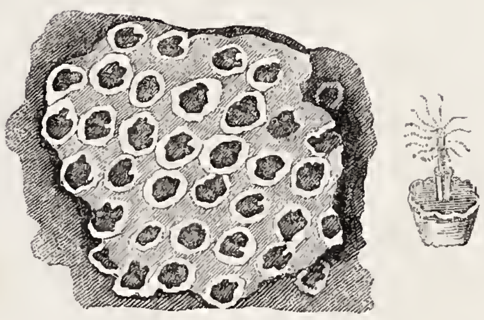
3791.—Flustra Carbasea.



3785.—Brachionus urceolaris.



3793.—Flustra avicularis.



3792.—Flustra dentata.

3797.—Pherusa tubulosa.

3796.—Elzerina of Blainville.

3794.—Flustra avicularis.

carbonate of lime deposited to form these spines assumes a semicrystalline structure, its particles obeying the laws of chemical affinity. According to some the cleavage of these spines presents the rhomboidal angles characteristic of carbonate of lime.

The Echinus subsists chiefly on young shell-fish, crabs, &c., and is provided with a very curious dental apparatus, surrounded by fimbriated lips and long tentacles. The plates around the mouth are small and less immoveably compacted together than those of the other parts, and admit of being altered in position by the movements of the teeth and oral margin. From the oral orifice the points of five three-sided prismatic teeth protrude externally and converge together, so as to act on prey by the working of muscles upon the osseous jaws, in which they are imbedded. The jaws are five in number, and each jaw examined separately resembles a triangular pyramid; when in their natural situation they form a five-sided cone. The teeth they support have the points extremely hard, yet, as in the case of the incisors of a rabbit, they wear down by use, and grow as they wear down, from soft and fibrous roots upon a secreting pulp. Each jaw is acted upon by powerful muscles, and the whole is based upon a curious osseous framework of levers with corresponding muscles, too complicated to be understood from a mere description.

From the mouth a narrow gullet leads to the digestive tube, which coils loosely twice round the inside of the shell, and terminates at the part of the shell opposite to the mouth; it is supported by folds of mesenteric membrane. The nutritive fluid absorbed from the digestive tube enters a vein which runs the whole length of the alimentary canal, and terminates in a vascular ring round the mouth, whence arteries are given off to the different parts of the system. Aëration is effected by the absorption of water into the cavity of the shell through minute orifices, distinct from those through which the suckers are protruded. At certain periods of the year five internal sacculi are found distended with eggs, which, under the name of the roe of the sea-egg, are in request as an article of food in the South of Europe and along the Mediterranean. This roe is of a reddish colour, and said to have an agreeable flavour.

In the depressed Scutellæ the ambulacra and their suckers are but imperfectly developed; and the shell is covered over with minute spines like fine short hairs; these, when microscopically examined, are found to be of the most admirable and elaborate structure; consisting of a series of joints of several facets, and furnished with most minute spikes. These miniature spines are articulated to the shell by a ball-and-socket joint. By the action of these instruments the Scutellæ bury themselves with great facility. In Spatangus (Fig. 3778) the body is oval, and the ambulacra form four leaf-like impressions diverging from the mouth; the ejestive orifice is terminal. The spines are short, flat, sessile, and scattered. In the figure these spines are wanting. The shell is delicate. Fossil Echinidæ abound in various strata from the transition beds upwards; in the chalk they are extremely common. We have before us several perfect specimens from Gravesend.

Let us now turn to the Holothuridæ and Fistularidæ.

Fig. 3780 represents—1, Holothuria Phantapus; 1 *a*, appendages round its mouth; 2, Holothuria papillosa; 2 *a*, a branch of its oral appendages isolated; 3, Holothuria vittata; 4, Holothuria cucumis; 5, Holothuria tubulosa; 5 *a*, it oral extremity; 5 *b*, its terminal extremity; 5 *c*, some of the cirrhi which cover the body, of the natural size.

In the Holothuridæ there is no calcareous box, but the body is invested in a dense fibrous skin of considerable thickness, covered externally with a thin epidermis, lubricated by mucus; internally there is a subcutaneous tissue of a semicartilaginous structure, with tendinous fibres crossing in various directions, serving to retain the shape of the body, which recovers itself when bent or distended. The form varies, but is in general more or less elongated, whence the common appellation of sea-cucumbers. Most of these animals inhabit the warmer seas, and in China certain species are accounted delicacies.

These animals, though wanting plates and spines, are still furnished with retractile suckers or feet, diversely arranged in different species. In H. Phantapus, of the European Seas, the feet are disposed in three rows along a sort of disc on the ventral surface. When the animal creeps along, it raises the two extremities of the body. In H. papillosa the body is covered with retractile papillæ or suckers. In H. tubulosa the ventral surface alone is covered with papillæ. In the vermiform H. vittata the papillæ are small and scattered. In H. cucumis there are five double rows of these suckers running longitudinally, and the body is pentagonal.

Besides the skin and fibro-cartilaginous tissue, there is within a pannicle of strong muscular fibres forming bands, which pass obliquely, longitudinally, and in a circular direction, the movements of the animal being thus amply provided for.

This muscular pannicle is lined with a peritoneal membrane, of which reflected ribands support the viscera. The contractile power of this muscular tunic is very great, and its irritability extreme, inasmuch that the slightest stimulus causes violent and uncontrollable contractions. Thus it mostly happens when one of these animals is captured, that it is thrown into such an inordinate state of spasmodic rigidity, as to lacerate the viscera and produce death.

The mouth is a simple contractile orifice, supported by very fragile calcareous pieces, of no use as teeth, but serving for the attachment of muscular fibres; it is surrounded by tentacula, or fringed appendages, varying in different species, and which are organs of touch and prehension. They are capable of being protruded and withdrawn internally. The alimentary canal is extremely long, but simple, and its length may be the more requisite from the circumstance that the Holothuria swallows sand, the débris of corals, portions of sea-weed, &c., from which the nutritive matter, of inconsiderable quantity in proportion, has to be extracted.

The respiratory organs of the Holothuridæ are very beautiful: they consist of two long tubes, rising from a cloacal sacculus, and giving off branches dividing and subdividing into the most delicate arborescent ramifications, till their minuteness becomes extreme. One of these arborescent branchiæ is spread over the viscera, the other is attached to the inner surface of the peritoneal lining of the muscular tunic. Through these tubes is the water forced by the contraction of the sacculus from which they spring, and in their extreme ramifications the aëration of the circulating fluid is effected.

Long and numerous ovigerous tubes open by a common canal in the neighbourhood of the mouth. The circulatory and nervous systems are not definitely understood. It would appear that in all there are salivary follicles.

In the Moluccas, the Pineapple Holothuria (H. Ananas), nearly two feet long, is in high request as food; indeed a great Oriental traffic in Holothuriæ is carried on, fleets of Malay proas visiting the islands north of Australia, the coast of New Holland, Timor, New Guinea, Ceylon, &c. from Macassar, for the fishery of the Trepang, or Tripang, as these animals are termed. On the return of the fleet to Macassar the fishermen are met by the Chinese traders, who purchase the cargoes of the vessels. The animals are procured by diving. They are split, dried in the sun, and smoked over a wood fire. In the market of Macassar not less than thirty varieties are distinguished. They are then packed into piculs, each picul being one hundred and thirty-three pounds and a half, and about one hundred piculs form the cargo of a single proa, averaging from forty to fifty dollars a picul. The black sorts, called "baatoo," are in most request; the gray or white, called "koro," are in less esteem, the picul being not worth more than twenty dollars. Besides Tripang, these vessels trade in shark-fins, and the edible nests of certain species of swallows. The quantity of Tripang annually sent to China from Macassar is about seven thousand piculs, or eight thousand three hundred and thirty-three hundredweight. Crawford says it varies in price from eight dollars to one hundred and fifteen dollars the picul according to quality. We learn from M. delle Chiage that the poorer inhabitants of the Neapolitan coast eat the Holothuriæ of the Mediterranean.

We may now turn to the Fistularidæ, which in many points closely approximate to the Annelidæ. They have a worm-like body, and are entirely destitute of suckers. They bury themselves in holes in the sand in shallow parts of the sea, and from these retreats protrude the head for the purpose of procuring food or for respiration, and the enjoyment of warmth; but they seldom emerge entirely. One species, Siponculus edulis, is in esteem among the Chinese of Java as an article of food; and a species found on the sandy coasts of Europe, Thalassema echiurus, is used as a bait by fishermen. The skin, with its muscular pannicle, is much the same as in Holothuria, and the oral orifice is surrounded by tentacles, which are highly sensitive, and are organs for the acquisition of food. The alimentary canal is long and simple, but greatly convoluted, and forming two loops, terminates at at the upper third of the body. There is a distinct venous and arterial system; and nervous ganglia upon the œsophagus, whence radiate nervous filaments to different parts of the body, may be readily detected.

Among the principal genera of this family, "Les Echinodermes sans pieds" of Cuvier, may be enumerated Molpadia, Minyas, Lithoderma, Siponculus, &c. Cuvier also refers to it the genus Bonellia, of which one species, the Bonellia viridis, Fig. 3781, is a native of the Mediterranean.

In this genus the body is oval, and gives off a long proboscis, consisting of a folded strip or narrow plate; this proboscis is capable of great elongation and contraction, and divides at its extremity into two branches. The Bonellia viridis buries itself deep in the sand, its proboscis alone emerging to reach the water, or, if this be low, during the ebbing of the tide, to gain the air. The forked extremity of the proboscis is not rolled up so as to form a complete tube, but resembles a split reed; it is moveable in all directions, and doubtless serves for the seizure of food, which is conveyed down the stem of the proboscis to the long and highly convoluted alimentary canal.

CLASS CÆLELMINTHA (OWEN).

The class Cælelmintha contains certain Entozoa or Parasitic Worms, in which the sexes are distinct, and in which nervous filaments and sometimes even nervous ganglia can be detected. There are moreover distinct muscles, and a digestive apparatus enclosed in an abdominal cavity. As examples we may mention the Guinea-worm (Filaria Medinensis) which buries itself in the skin; the Filaria oculi, a minute species which has been found in the aqueous chamber of the eye; the Linguatula; and various species of Ascaris.

At Fig. 3782 we see two of these Cælelmintha, the lower specimen being evidently one of the Sterelminthous group.

Fig. 3783 represents the Strongylus equinus: it is furnished with a spherical head, and the mouth is armed with soft spines. This species penetrates into the arteries of the horse by some unaccountable method, and in attacks of bronchitis numbers are often found in the larynx and bronchial tubes of that animal after death.

CLASS ROTIFERA

(WHEEL-LIKE ANIMALCULES). This singular class of microscopic beings was formerly confounded with the Polygastrica under the general title of Infusoria. The Rotifera are, however, not only distinct, but occupy a far higher grade in the scale of organic life. They derive their name from the appearance of wheels turning round and round, near the mouth or at the upper part of the body, with great velocity. This appearance is deceptive, and is found to arise from circlets consisting of minute cilia, which in rapid succession bend and unbend, producing the effect sometimes of waves chasing each other in a ring, at other times of wheels in rapid whirl. These cilia are sometimes quiescent, sometimes only partially agitated. They propel the microscopic beings through the water, and moreover serve for the acquisition of food. Fixing itself by means of a caudal forceps to any object, the animal throws its cilia into violent action, producing a whirlpool in the contiguous water, conveying to its mouth and hurrying thither such minute particles of animal or vegetable matter as are drawn into this mimic Charybdis. When not in use the cilia are retracted.

The Rotifera are divided into two orders, Nuda and Loricata; the former naked, the latter covered with a delicate transparent horny or calcareous tunic, through which the internal viscera may be seen. The mouth leads to a gullet, variable in size in different species, and this conducts to a gizzard or preparatory receptacle, termed by some the pharynx, which is muscular and armed with three curious teeth, for the purpose of comminuting the food; these teeth are extremely hard, but vary in size and shape in the different species. From this muscular teeth-armed gizzard a canal of variable length leads to the true stomach, to which are certain appendages, regarded by Professor Jones as the rudiments of a biliary apparatus. These appendages vary in form and number. Bands of muscular fibres have been also detected, and, according to Ehrenberg, even nerves and organs of vision. He also considers that there exists an extensive vascular system. With respect to respiration, he conceives that the water is admitted into the cavity of the body through a tube at its upper part, and rejected through the same, the body alternately contracting and expanding, and that certain little vibrating points attached to two lateral undulating viscera perform the office of branchiæ.

The Rotifera are oviparous, but the eggs are sometimes hatched before exclusion; they appear under the microscope like minute transparent globules, in which the enclosed young animalcule may be distinctly seen.

The Rotifera are active and vivacious creatures, and by the vigour and address of their movements surprise those who observe them: to these tiny creatures a drop of water is a lake, in which mul-

tudes revel, performing a thousand evolutions, and yet avoiding each other in their mazy dance. They evidently enjoy existence, and are highly organized.

Fig. 3784 represents Brachionus urceolaris, one of the Loricate group: *a a*, the rotatory cilia; *b*, internal branchial organs; *d*, the eye; *e*, gizzard and jaws; *f*, stomach; *g*, appendages of stomach; *h*, egg-sacs; *i*, the tail.

Fig. 3785 represents the same still more enlarged: *c*, cilia; *p*, pharynx, or tooth-armed gizzard; *e*, stomach; *a p*, appendages to the stomach; *o v*, egg-sacs; *m*, muscles; *q*, tail; *o*, the eye; *b*, internal branchiæ: *c a*, branchial canal.

Fig. 3786, Notommata centrura, one of the naked Rotifera. The letters refer to the same parts as in Fig. 3785.

CLASS BRYOZOA, or MOSS CORALS.

The Moss Corals, or Ciliobranchiate Polypes of Dr. A. Farre, are of a higher grade in the scale of organization than the simpler Polypes, with which till recently they have been associated. They form a numerous class. Hundreds of microscopic fossil species have been recently detected by the labours of Ehrenberg and D'Orbigny, and it would appear that their shells or outer tunics enter into the composition of chalk-beds, compact mountain-limestone, the flints of the Jura limestone, the sea-sand of Europe, the Mauritius, the Sandwich and other islands, and the sands of the Libyan desert. Of these many are invisible to the naked eye; others resemble minute grains. Of these fossil forms many are still living. Some idea of the extreme minuteness of several of the fossil Bryozoa may be formed, when it is known that multitudes are present in the finest levigated whiting, without having suffered change in the preparation of the chalk; and that when spread out mixed, with water, a mosaic-work of these animalcules, of varied and beautiful forms, may be seen by means of a microscope.

To the Bryozoa, according to Ehrenberg, must be added the Foraminifera of D'Orbigny, which the latter naturalist regarded as constituting a family of the Cephalopodous Mollusks, and allied to the Ammonites. Of these Foraminifera, Milliola, Biloculina, Rotalia, Rosalina, Nodosaria, Cristellaria, &c., formerly considered as minute Ammonites, are examples. Ehrenberg places them in his Polythalmic order of Bryozoa. For an able exposition of Ehrenberg's system see the 'Annals and Mag. of Nat. Hist.' June, 1841, p. 296: and also the number for July. With respect to Ehrenberg's views, we have no space to discuss them, nor would such a review be here in place. The Bryozoa differ from the ordinary Anthozoa or Polypifera in possessing a distinct alimentary canal, contained in an abdominal cavity, and a circulatory system; there are distinct muscular fibres to be detected by means of a powerful microscope, and also nervous filaments. As examples of these curious animals we may enumerate Lunulites, Cellepora, Flustra, Eschara, &c.

The genus Lunulites is known only in a fossil state. These fossils present us with an arrangement of cells with an opening above, disposed upon a single stage in concave circles or diverging rays, so as to form a cretaceous polypary (as the cells of polypes are termed), of orbicular figure, convex above, concave below. Fig. 3787 represents Lunulites radiata, from Grignon, &c.: *a*, the upper side; *c*, the under side; *b*, natural size.

Fig. 3788 shows Defrance's "Lunulite en parasol," the type of the genus Cupularia: *a*, a portion magnified to show the cells in which the polypes resided; *c*, three cells, more highly magnified; *b*, the fossil, natural size. With these may be compared the Nummulites lenticularis (Fig. 3789), one of the fossil Foraminifera of D'Orbigny.

With respect to Flustra, these Bryozoa vary very much in the form and character of their polyparies; sometimes they appear as a cluster of minute cells, extended on fuci, and resembling honey-combs in miniature, as Flustra eriophora; others form stems or leaves of a horny texture, sometimes cellular on one side only, sometimes on both. A large foliaceous Flustra common on our coasts (F. foliacea), has cells of a pear shape on both sides; these cells have elevated margins, armed with spines. Fig. 3790 represents the Flustra foliacea: *a*, the natural size; *b*, some of the cells, magnified. The extension of the cells of the Flustra takes place laterally, those in the central part of each foliation being often destitute of living polypes, while the external ranges of cells are tenanted. There are, however, limits beyond which the extension of the polyparies of the Flustra does not proceed. In the Flustra Carbasea, found on the coasts of Scotland, the cells are elongated. The polypes of this species have been examined by Dr. Grant: he states that the tentacles are twenty-two in number, with about fifty cilia in a row down the sides of each; there are about one thousand eight hundred cells on each square inch of surface; and the branches of an ordinary specimen present about ten square inches of surface, so that there are about eighteen thousand polypes on a single zoophyte. On the Flustra foliacea, there are at least twice as many, all actively employed, working their tentacles, and vibrating their cilia which cover them, in order to obtain their food.

Fig. 3791 shows—*a*, a portion of Flustra Carbasea, natural size; *b*, a portion magnified.

We have said that some of the Flustræ, instead of being foliaceous, encrust other bodies. Fig. 3792 shows an encrusting species, the Flustra dentata of the Northern Seas, magnified with a representation of one of the polypes protruded from its cell, with its ciliated tentacles spread.

Some Flustræ, we may add, are parasitic upon others; on the Flustra foliacea for example, a parasitic Bryozoon takes its abode and spreads in patches on its cellular fronds. This singular Bryozoon is the Valkeria imbricata (Bowerbankia densa of Dr. Farre). As its structure has been well investigated, we shall give an outline of it, in order to elucidate the general structure of the polypes of this class. The polypes of the Valkeria inhabit each a transparent horny tube, about a line in length, and clusters of these tubular cells rise from a common creeping base or stem. The polype, when protruded from the orifice of its cell, spreads out ten long slender tentacles, surrounding the mouth; on the outer face of each tentacle is a series of stiff spines, and besides them a multitude of vibratory cilia, which the little creature throws at will into the most rapid movements, so as to produce a vortex gyrating to the mouth. The mouth is simple, leading to a capacious gullet, which, gradually narrowing, terminates in a muscular gizzard of a rounded form, to which succeeds a long conical stomach with glandular walls. The gizzard has its inner membrane tessellated with minute teeth.

The alimentary canal emerges from the upper part of the stomach, and terminates below the base of the tentacles.

When the animal withdraws into its tube, two muscles, rising from the tube, and inserted one into the gullet, the other into the lower part of the stomach, contract and throw the alimentary canal into tortuous folds. But besides these two muscles there is a set connected with the tentacular apparatus, for closing the tentacles. It must be here observed that the cell itself may be divided into three portions: first, a basal horny transparent portion, firm and unyielding; secondly, a soft flexible continuation; and thirdly, a marginal circle of bristle-shaped appendages connected together by a filmy web, like the rays of the fin of a fish. When the polype withdraws itself, the tentacles are first folded up into a close bundle and then retracted, the œsophagus retiring at the same time. With the descent of the œsophagus the soft part of the tube begins to be inverted, and the setæ, or bristles, close together; these are drawn inwards till they disappear, the soft tubular part forming a sheath round them: the whole constituting a sort of stopper shutting up the polype in its horny case.

Six distinct fasciculi of muscles, arising from the hard portion of the tube, act upon the flexible portion of the tube as retractors.

The polypes of Flustra are modelled nearly upon the same plan as those of the Valkeria (or 'Bowerbankia'), but their extreme minuteness and the incomplete transparency of the cells render their microscopic examination more difficult.

It would seem as if a group of Rotifera rendered stationary, with their cells united, so as to form a foliaceous expansion, would be then so many Bryozoa; and indeed there are not wanting links which connect these two forms of life together. Among other examples of the Bryozoa, we select the Flustra avicularis, a native of the European seas.

Fig. 3793 shows a spherical mass of Flustra avicularis, of the natural size. Fig. 3794; *a*, the root and foliaceous form, of the natural size; *b* and *c*, portions magnified.

Fig. 3795 shows the polypary of Electra verticella (Flustra verticellata, Gmelin): *a*, the natural size; *b*, magnified. The polype is unknown.

Fig. 3796, Elzerina Blainvillii: *a*, the natural size: *b*, magnified. Animal unknown. Locality, the seas of Australia.

Fig. 3797, Pherusa tubulosa (Flustra tubulosa): *a*, the upper side; *b*, lower side; *c*, a portion magnified.

Fig. 3798, Cellaria ceroides, from the Mediterranean and Indian seas: *a*, the natural size; *b*, a portion of the lower part, magnified.

Fig. 3799, Cellaria Salicornia, from the European seas: *a*, the natural size; *b*, a portion magnified; *c*, a smaller portion still more highly magnified.

Fig. 3800, Cellaria loricata, of the natural size, and a branch magnified to show the cells.

Fig. 3801, Canda arachnoidea: *a*, the natural size; *b* and *c*, portions magnified. This Zoophyte Bryozoon is a native of the Australian seas.

Fig. 3802, Cabcrea dichotoma: *a*, the natural size; *b*, two cells, magnified.

Fig. 3803, Acamarchis neritina: *a*, the natural size; *b*, the lower portion, magnified, showing the cells. This species is found in the Mediterranean.

Fig. 3804, Gemmicellaria bursaria: *a*, natural size; *b*, a portion magnified. Locality, the European seas.

Fig. 3805, Unicellaria chelata: *a*, the natural size; *b*, a portion magnified. Locality, the European seas.

Fig. 3806, Menipæa hyalina: *a*, the natural size; *b* and *c*, the cells, magnified. Locality, the Indian seas.

Fig. 3807, Eschara foliacea. The magnified portions show the arrangement of the cells, on a frondescent or leaf-like polypary.

Fig. 3808, Andonea folifera, a foliaceous species, with minute cells, or leaf-like polyparies.

Fig. 3809, Cellepora pumicosa: a spongy mass of minute cells encrusting the branch of a zoophyte.

Fig. 3810, Retipora cellulosa: a species with leaf-like expansions, having the cells opening on one face only.

Fig. 3811, Discopora verrucosa. The two figures show this species of the natural size and magnified. The cells are close and elevated, and encrust other bodies. The polype is unknown.

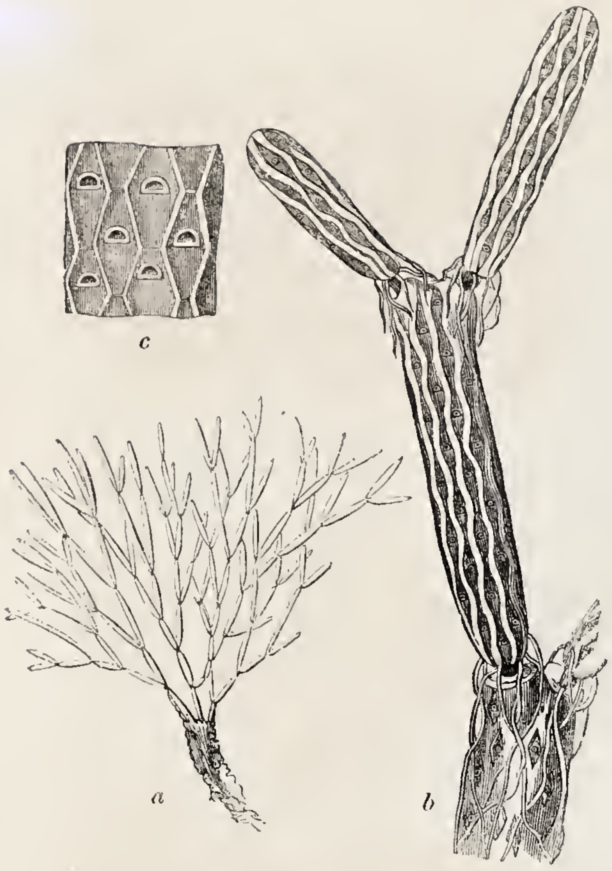
We may here observe that the Bryozæ, or Ciliobranchiata, constitute the order Zoophyta ascidioïda of Dr. Johnson, and the family Operculifera, or Escharizea, of other naturalists. Though structurally elevated above the ordinary Zoophytes, or Phytozæ of Ehrenberg, which in their general mode of existence, in their poliparies, and plant-like aspect, they resemble, it will be necessary, in order to understand this group of beings, to obtain clear and precise ideas of the simple Polypes, between which and the Rotifera and the stemmed Echinodermata, or Encrinites, they seem to form a link of union.

The simple or ordinary Polypes, Phytozoa, are placed in the Acritous subkingdom, viz. that in which no distinct nervous system is to be discerned; to this subkingdom we will immediately direct our attention, and beginning at once with the lowest forms of animal creation, the Sponges, pass up the ascending grades of existence which that subkingdom presents. It is in this way only that we shall be able to render the subject clear to our general readers; and at the outset, we must admonish them, that the ideas of life and organization which are derived from a consideration of the higher classes of the animal world, where we find nerves, blood-vessels, viscera, and muscles, must be set aside. We are about to contemplate animal life in its simplest phase, and, marking as it were its dawn, trace up its primordial developments.

SUBKINGDOM ACRITA.

THE beings of this subkingdom, which, with the exception of certain Entozæ, are all aquatic, present us with varied forms; all however consist essentially of a gelatinous and, it appears, homogeneous substance, of which the solid constituents bear but a trifling proportion to the fluid. This homogeneous gelatine is sometimes unsupported by any kind of framework; in other cases, it either invests a support or is contained in a sort of external case or investment formed by the process of secretion. In the substance of these animals no nerves have been detected, but nervous molecules are probably blended with it; there are no true blood-vessels, yet in some canals are excavated in the substance, through which fluids, absorbed, circulate and are carried to a central cavity; and this apparatus fulfils at once the purposes of nutrition and aëration. In some a more perfect digestive laboratory is present, and a more definite respiratory apparatus. In most, no muscular fibres are to be perceived, yet of these many contract and expand their bodies, and are furnished with moveable and sensitive tentacles by which they seize their prey. Many are capable of locomotion, but others are fixed like the plant to one spot for life. Some secrete a fluid of an irritating quality which gives great pain to the hand with which it comes in contact. There is ordinarily no distinction of sexes, and reproduction takes place either by the simple division of the body, by granular ova, or gemmules which become detached from the parent body, the form of which they ultimately assume.

In many instances the Acrita form compound animals: numbers united together, form a vital whole, constituting one animal, if we regard it in some points; but many, if we regard it in others. Such are the Zoophytes, the Diphyes, and others. In the case of the latter, the body consists of two portions, a larger and smaller; but the junction is so slight, that it is almost impossible to understand the nature of the connexion between them, the more especially as their separation is not destructive of life. Leaving these general observations, we



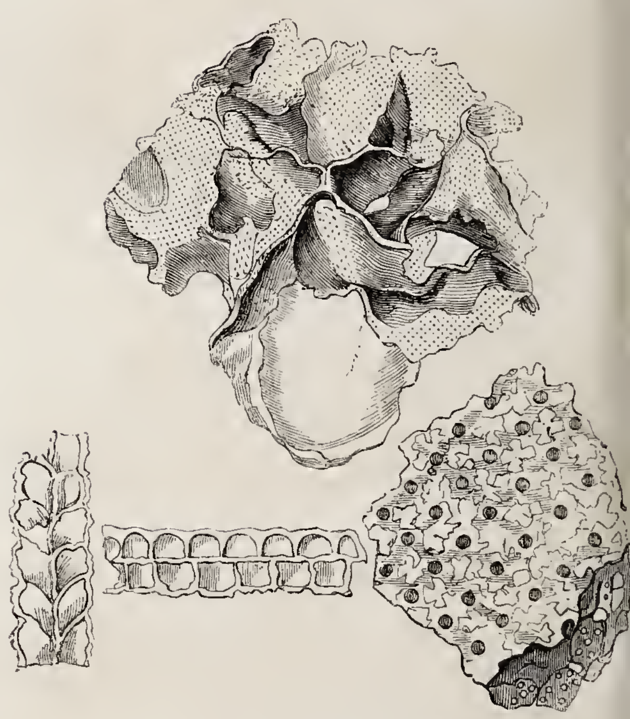
3799.—Cellaria Salicornia.

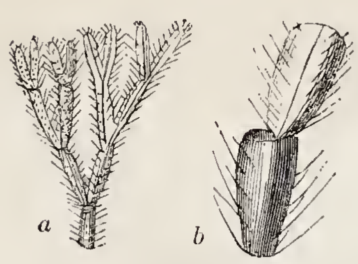
3803.—Acamarchis neritina.

3805.—Unicellaria chelata.


800.—Cellaria loricata.

3806.—Menipæa hyalina.

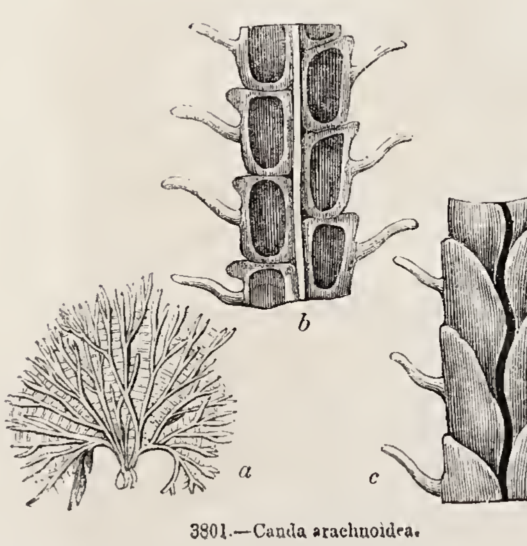

3807.—Eschara foliacea.



3802.—Caberea dichotoma.

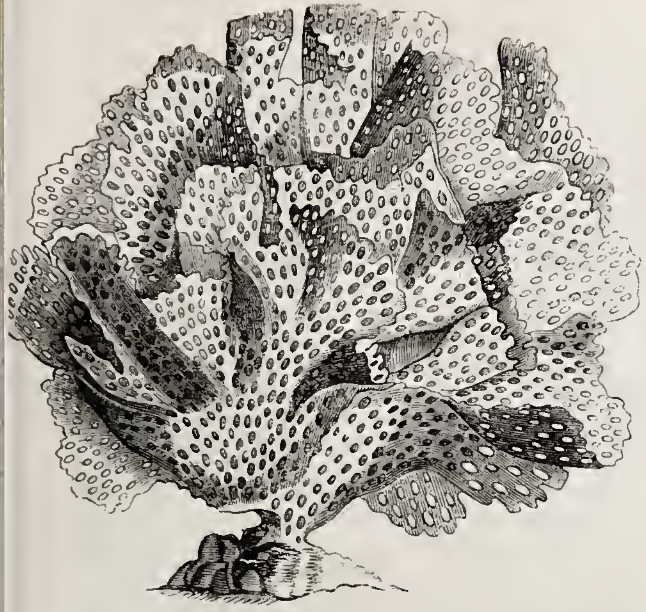
3804.—Gemmicellaria bursaria.


3808.—Andonea foliifera.

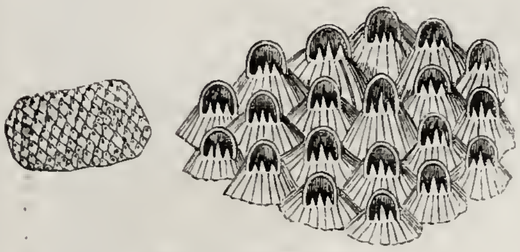


3801.—Canda arachnoidea.

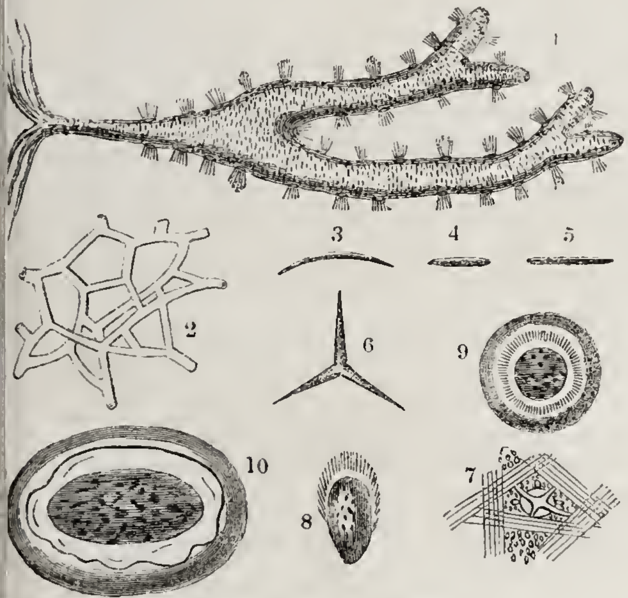

3809.—Cellepora pumicosa.



3810.—Retepora cellulosa.



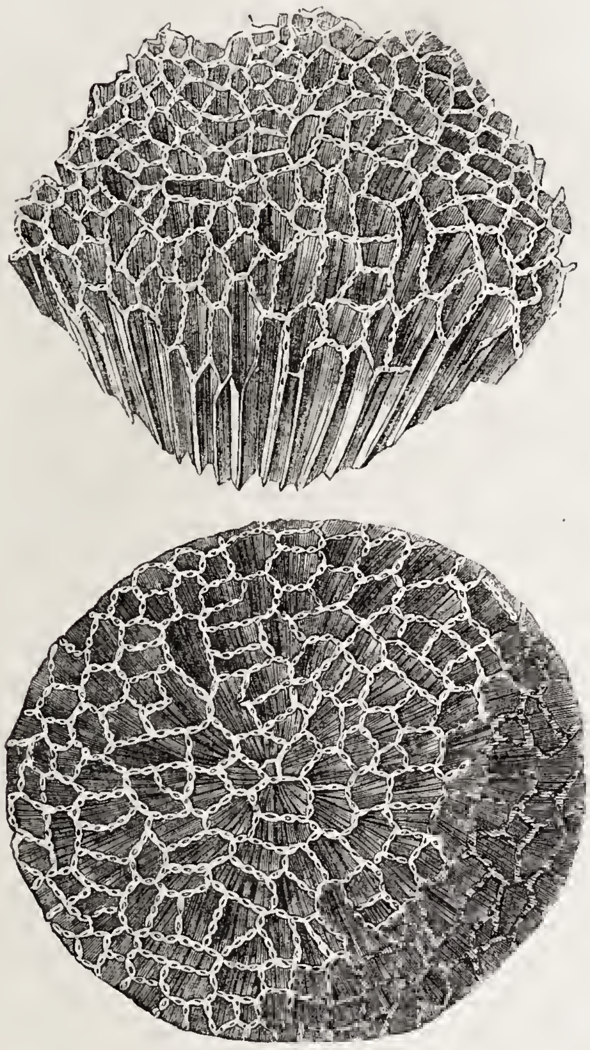
3811.—Discopora verrucosa.



3812.—Spongia oculata and structure.

3813.—Fungia patellaris.

3816.—Syringopora geniculata.

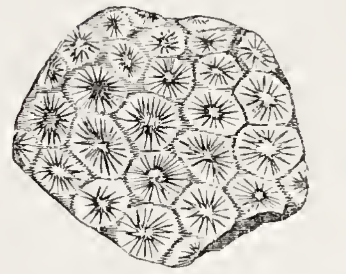


3815.—Catenopora escharoides.

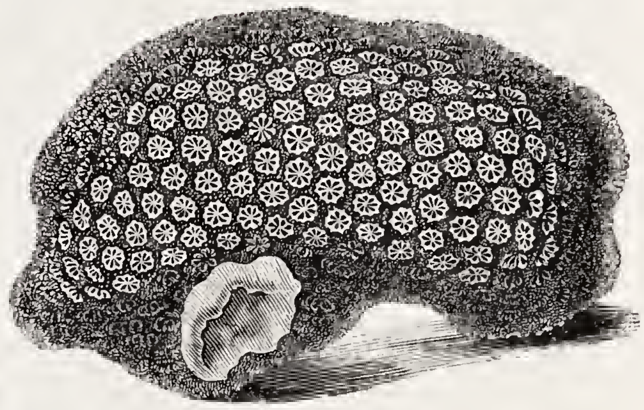
3814.—Caryophyllia cyanthus.

3817.—Meandrina Dædalæa

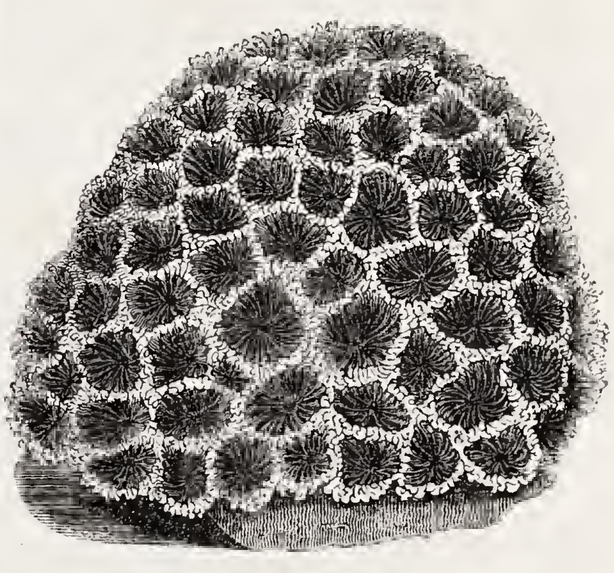
3818.—Pavonia boletiformis.



3819.—Astræa ananas.



3820.—Astræa rotulosa.



3821.—Astræa favosa.

3822.—Oculina axillaris.

shall proceed to a more definite review of the classes into which the subkingdom Acrita is divided.

CLASS PORIFERA

(SPONGES).—Who that takes up a piece of sponge would regard it as an animal production? yet such is it regarded by most zoologists. Sponge however, as ordinarily seen, is not the animal itself, but the framework upon which the living mass is sustained. In its original state it was invested with a filmy coating of transparent granular gelatine, every fibre, every filament being covered, as if indeed it had been dipped in jelly. It is this gelatine, replete with transparent granules, which really constitutes the animal, and it is this that produces the cellular framework called sponge.

It is in the seas of the warmer latitudes, that sponges are principally to be found there; they luxuriate, attaining to the largest dimensions, and displaying the most varied forms. Fixed to the rock, they festoon the deep sea caves, line the walls of submarine grottoes, and hang like fantastic pendants from the roof; some like inverted vases, some like fans, some like intertwisted branches.

The common sponge of the Mediterranean was well known to the ancients, and applied to the same purposes as at present. The London market is supplied from several quarters, and distinct species are in use, varying in their quality. If we take a portion and examine it, we shall find it made up of a maze of elastic horny fibres crossing each other in all directions, and forming a cellular mass permeated by innumerable pores, which, when the sponge is dipped in water, absorbs the fluid by capillary attraction. Besides these minute pores we find large and definite canals opening on its surface and which traverse its substance. Now, in its natural condition, invested with living gelatine, the sponge is perpetually imbibing sea-water through the pores, which saturates the whole mass; this is again expelled in streams through the canals, and thus a constant circulation is maintained. This is the amount of our knowledge respecting the aëration and nutrition of the sponge. It is indeed probable that by some process of absorption the sponge takes up and incorporates nutritive matter; but how the circulation of the sea-water is affected is still a mystery. It has been said by Lamarck, Lamouroux and others, that sponges when touched exhibit slight tremulous or contractile movements; but later observers, as Dr. Grant, MM. Audouin and Milne Edwards, assert the contrary, and affirm that no wounds or lacerations elicit the slightest tremor in the living gelatine. There are moreover no vibratile cilia for the production of currents; and consequently by what agency this palpable circulation is effected has yet to be demonstrated. As every part of a sponge is similarly organized, and carries on the same functions, it will hardly surprise us to learn that if divided into portions each piece becomes an independent being, yet it is not in this manner that it multiplies. The sponge is gemmiparous; it gives birth to gemmules, or little oval granules, the rudiments of future sponges. At certain seasons of the year the canals traversing the sponge are found to have their gelatinous lining studded with little yellow buds sprouting from it; these increase and at length become detached, and are carried out by the stream of water. Strange to say, these gemmules appear to be more highly organized than their parent. Their figure is egg-shaped, and their larger extremity is covered with numerous vibratile cilia, which are rapidly agitated, producing currents in the surrounding water, and propelling them along. Thus they swim, free and active, to a considerable distance, till a suitable locality offers for their settlement; they then attach themselves, never to remove; the cilia disappear; they begin to grow, assuming their specific form, develop their horny or silicious framework, and in turn give origin to other progenies. The wisdom of this arrangement is very evident: the sponge affects calm and tranquil spots, and were the myriads of gemmules to become fixed at once, on exclusion from the parent, the spot would be grown up with sponges, and the distribution of the species throughout the sea would depend upon mere casualties.

The fibrous struction of sponge may be considered as the rude skeleton of the living animal; and the characters of this framework vary greatly in different species. Those of the sponge in ordinary use are too well known to be detailed, but in many this framework consists of a firm inflexible tissue of interwoven filaments, which are tubular; the living gelatine is also firmer, and not only exhibits bands of a more tenacious or cartilaginous consistence than ordinary, but is more or less replete with minute crystallized spicula, generally fusiform, sometimes three-rayed. Multitudes of the spicula are placed around the internal walls of the canals which they line. They may be obtained by washing a sponge of which the animal matter is decomposing, or by fusing it before the blowpipe. They are found to consist of silica, or flint, and, minute as they are, are capable of scratching glass. In the genus Tethya the framework consists almost entirely of silicious spiculæ or filaments, and quantities are found in the ashes of Spongilla fluviatilis and other species: a minute portion of silica has been found in the ashes of the common sponge; and it appears that in proportion to the density of the fibres of the sponge is the proportion of silica entering into their chemical composition. In elastic sponges the fibres consist principally of animal matter. Fig. 3812 represents —1, the Spongia oculata, of the British coast: in this the pores are seen and the canals from which the currents are issuing; 2, the anastomosing horny fibres of common sponge; 3, a silicious spiculum of Spongia papillaris; 4, of Spongia cinerea; 5, of Spongia panicea; 6, a calcareous spiculum of Spongia compressa; 7, transverse section of a canal of Spongia papillaris, to show the structure, and the gemmule passing along the canal; 8, gemmule of Spongia panicea; 9, the same, seen at its larger end, with a circle of water produced by ciliary action; 10, young Spongia papillaris commencing to grow from a gemmule attached to the rock.

Sponges, like plants, while retaining their specific characters, luxuriate in individual differences; the general form, the general aspect of each species is preserved, but as no two plants precisely correspond in the number of branches or of leaves, so do these in like manner vary as accidental circumstances may determine. When torn or injured, sponges repair the wound; we have several specimens that have been lacerated, and show distinctly the new matter by which the hiatus has been filled up.

Fossil sponges are numerous; they are found in the oolite, in the green-sand formation, and in a silicious state in the chalk.

CLASS PHYTOZOA

(*Anthozoa*, Ehrenberg; *Polypifera*, Grant; *Zoophytes* of older authors).

Passing from the non-irritable sponges, we advance to a class interesting from the nature of the subjects it comprehends, and from their varied forms and elegant appearance. Many indeed, at a first view, so closely resemble delicate sea-weeds, that we are not surprised to find them considered as such by persons who have collected them on the shore, where they may be observed, some attached to shells, some to pebbles or stones, and others to the fronds of fuci. Their true characters indeed have been but recently understood, and their first elucidation is due to John Ellis, F.R.S., whose paper on the History of Corallines and other marine productions found on the coasts of Great Britain and Ireland was read before the Royal Society, in June, 1754.

Though on our coasts many beautiful species of the more plant-like species exist, as Thuiaria, Campanularia, and Sertularia, it is in the warmer latitudes of the ocean that the Phytozoa, or Polypifera, display their wonderful variety of forms, from fans of network, or streamers, bending like osiers before the waves, to corals with chaliced flowers, and Madrepores, which encrust rocks, form reefs dangerous to the navigator, or rise in islets covered with intertropical vegetation.

In order to convey a clear idea of these polype-bearing animals, let us begin with the simplest of their forms. There is in fresh water a minute gelatinous creature termed Hydra, of which several species are known (as H. viridis, H. vulgaris, H. fusca, &c.). These animals are of slender figure, with an internal cavity, and an oral orifice surrounded by moveable arms or tentacles. They possess the most extraordinary powers of contraction and elongation, and are highly carnivorous; they attach themselves by means of a caudal sucker to the leaves of aquatic plants, and spread abroad their arms in quest of prey, which they drag to the mouth and engulf. No nerves or muscular fibres have been detected, but the gelatine composing the body is replete with minute granules. The Hydra is tenacious of life, and when cut asunder, each part becomes a perfect and independent being: yet though apparently insensible to pain, it appears to appreciate the presence of light; and its tentacles doubtless feel the prey round which they cling. The Hydra is free, and moves about over the surface of leaves, or swims in the water with the tentacles downwards, the caudal sucker acting as a float; when alarmed, it contracts its tentacles and shrinks into the form of a small globule, easily escaping observation. These minute creatures are not uncommon in clear ponds or slow rivers. In the Hydra we have an example of a free, independent, gelatinous polype of the simplest structure, the digestive apparatus being a simple excavation of its substance; it is itself a digestive sacculus; a stomach fringed with tentacles for its own supply.

Now suppose one of these should expand greatly and deposit within itself a calcareous substance, acting as a sort of rude skeleton, invested with gelatinous film, much as we have seen in the sponge, and become, though not fixed, incapable of locomotion. Such a being we have in the Fungia, one of the Madrephilliæa of De Blainville; the stony axis or polypary of which has the upper surface adorned with radiating plates, rendering it not unlike a mushroom. These animals are found in the Indian Seas, and lie loose and unattached upon the soft sand at the bottom of the water. The gelatinous investment is contractile, and reproduction takes place by buds or gemmules, which grow, become at length detached, and are carried away by the waves. Fig. 3813 shows Fungia patellaris: *a*, the upper face, *b*, the lower; the middle figure is a side view, the other shows the section of a portion.

Here then we have an example of an independent polype investing a radiated skeleton, though all the species have not tentacles. In many, however, as in Fungia actiniformis, they are numerous, and thick on the upper disc, in the centre of which is the mouth.

Let us advance another step, and fancy a gelatinous extension, common to many polypes, united as it were into one compound unity, and secreting for the internal support, or skeleton, a branching calcareous tree, with cells on the branches, in which the polypes are lodged, and from which they may protrude and expand their tentacles; such we have in branched madrepores, as Oculina, Dentipora, Millepora, &c. In other instances the gelatine may secrete large calcareous masses for its support, with polype cells variously arranged, as in Astræa, Meandrina, &c. In these instances the calcareous support is firmly consolidated to the rock on which it is based, and the polypes, often of most beautiful tints, resemble thickly scattered flowers on a glistening bank or silvery tree. We must not suppose, however, that a solid calcareous axis is always deposited—on the contrary, sometimes, as in Gorgiona, we find the axis horny and elastic; in this case it is generally in form of a fan, or like a branch of the weeping-willow, and, rooted on the rock, bends to waves. In these instances there are no polype cells in the horny stems or twigs, but only in the gelatinous bark, or cortical substance which invests them, and in these do the animal flowerets dwell. In other cases, as in the Isis Hippuris, the stem is composed alternately of joints of flexible horny matter, and of calcareous substance, resembling interrupted beads of white. This stem is clothed with the gelatinous bark, of considerable thickness, in which are the polyparies, or polype cells.

So far we have described the general nature of Phytozoa, in which the living gelatine, uniting multitudes of animal flowerets or polypes, invests an axis differing in form and substance. Let us, on the contrary, now picture a number of polypes united by threadlike films into one being, and these threads cased within a tubular sheath of horn, which they have secreted. Let us picture the whole as a tuft of delicate vegetation, a frondescent plant of tubular horn, with orifices or cups or bells bestudding every branch, in which the polypes reside, and from which they can protrude their contractile tentacles. Such have we in the Sertulariæ, compound tubular Phytozoa, which we find rooted to stones and shells in abundance on our own coast.

There are, however, some Phytozoa which inhabit calcareous tubes, and in some instances these tubes are collected into masses of considerable extent, all ranged in order, like reeds bound together, or the pipes of an organ; they are open at one end, through which the polypes, independent of each other, except when they form the bands or stages which unite the pipes together, protrude their flowerets. Such is the beautiful Tubipora musica, of a deep red.

Distinct alike from the cortical and the tubular Phytozoa are the Alcyonidæ. In these there is neither a calcareous axis nor a horny or calcareous sheath; but a firm cartilaginous mass, with calcareous spicula dispersed through its substance, at least in some instances, is studded with hydra-like polypes, each in its own cell, the cells being excavated in the living gelatinous mass, to the nutriment of which, as the common bond of union between them, they all alike contribute. These may be called compound cartilaginous Phytozoa.

A very strange form is represented by the Pennatulæ, or Sea-pens, of which Cuvier forms a distinct group. Here we find a calcareous stem with lateral branches disposed on each side, the whole bearing some resemblance to a quill-feather; along each branch are cells, in which the polypes reside, and these are united by a living filmy thread, sheathed in the branches and shaft. The Pennatulæ and Virgulariæ are free, and carried about by the waves.

Another form of Phytozoa is presented by the Actiniæ, or Sea-Anemonies, which are so abundant on the rocks along our shores, and to which they adhere by their base, expanding their richly-tinted arms in quest of prey. Some species are unattached. Al-

lied to them are the Zoanthi, united by common base to each other, this base being adherent to the rock. Here we have made a great advance in the scale of organization; we have in the structure of the Actiniæ, muscles, a true stomach, and nervous filaments.

So far we have endeavoured to render clear an idea of the nature of polypes, simple and compound, cortical or tubular: we have selected only a few of their principal modifications, by way of illustrating the general nature of the Phytozoa; our object being in this short introduction to lead the reader from the simple unclad polype to the compound forms, where congregated polypes are united into one living whole, while at the same time each acts for itself; one contracting, another expanding, at the same instant. In one sense we may consider each polype as a distinct being; in another sense, as forming a part of a compound unity through which vitality is equally diffused. In these aggregated forms, the polypes all labour to one end; they constitute a community, every individual of which contributes to the nutrition of the general body. But as there are no nerves, they can neither participate in each others movements or each other's feelings. If one polype be destroyed, the rest are unaffected. We commenced our observations on the Acrita by saying that all ideas of life derived from a consideration of the higher animals of creation must be banished, and a contemplation of the sponges and Phytozoa will surely justify our remark. Deadness to pain, yet feeling for light, contractility, expansibility, and motion without muscles; digestion and nutrition without lacteals, absorbents, or blood-vessels; reproduction by simple division or budlike sprouts; the vital unity of myriads, and yet their personal distinctness—these are characteristics which surprise the more, the more we reflect upon them; and when to these characteristics we add those taken from their rude skeletons, their horny tubes, their cells, their plant-like forms, and mode of attachment, we must confess that the Phytozoa are among the most mysterious of living things which the Fiat of Creative Wisdom has called into existence.

Let us now attend to our pictorial specimens of this class, taking first the Lithophytes, or Stony Phytozoa, into consideration.

To the Family Madrephylliæa of De Blainville belongs the genus Fungia, of which we have already spoken. (See Fig. 3813.) In some species there appear to be no tentacles, but in others tentacles exist, covering the upper surface. In Fungia crassitentaculata these are thick, conical, and hollow, of a brown colour, and transversely striated, terminating in a greenish yellow facet perforated by a minute orifice. They are strongly prehensile, urging to the mouth small crustacea or other animals on which the Fungia subsist. When alarmed the tentacles are withdrawn between the laminæ of the calcareous axis, and the flesh shrinks down and accumulates in the interstices. The Fungiæ, as we have said, are free, reposing on the sand; but the Lithophytes, as a rule, are rooted or fixed to the rock which supports their branched expansions or extended masses. To this group belongs the elegant Caryophyllia cyathus, Fig. 3814, in which the goblet-like cells are elevated upon a fixed calcareous base; the cups or cells are striated externally, and the polypes which they lodge have a single or double coronet of short, thick, perforated tentacula. The species are numerous. To the present group belong many forms found only in a fossil state, as Columnaria, Stylina, Catenopora, Syringopora, &c. Fig. 3815 represents Catenopora escharoïdes, from the transition rocks. It is a lamelliferous coral, with tubular and often oval cells, furnished with radiating plates, united laterally into a calcareous polypary of a conical figure, fixed, and composed of vertical fixed lamellæ.

Fig. 3816 represents Syringopora geniculata. Large masses of this coral occur in the carboniferous limestone, composed of tubular vertical cells, radiating interiorly, as may be seen by polishing a portion of the surface transversely to the direction of the tubes. The Syringoporæ were ranked by the older writers as Tubiporæ.

There is a group of corals termed Meandrina, or popularly Brain-corals, of which some splendid specimens may be seen in the British Museum. They are generally in the form of large rounded masses, exhibiting a surface covered with sinuous ridges winding in every direction, and anastomosing with each other, like mimic Alps with valleys between; from the centre of these valleys to the top of the winding ridges are multitudinous linear depressions or pits divided by transverse lamellæ. In a state of nature the whole of this mass is covered by a gelatinous film, and myriads of polypes, of minute size, with short tentacles, occupy the linear pits; so that when all become expanded and in action, the surface seems alive with countless beings; all active in the acquisition of food, or the extension of their calcareous polypary.

Fig. 3817 represents Meandrina Dædalæa, from the Indian Seas: *a*, the entire figure, reduced; *b*, a portion, of the natural size.

The genus Pavonia comprehends several very elegant lithophytes from the Seas of the East and West Indies and those of the South Sea Islands. They are distinguished by the foliated expansions of the calcareous axis, resembling clusters of cup-like flowers, or those singular fungi which we find growing on the bark of decayed trees. The polypes are destitute of distinct tentacles; and the cells in which they lodge are confluent, conical, and small. Large masses of these Lithophytes are in the British Museum.

Fig. 3818 represents Pavonia boletiformis.

M. de Blainville places under a section which he terms Madrastræa, various genera, as Astræa, Oculina, &c.

In Astræa the calcareous mass adheres to rocks, and has the upper surface covered with roundish or subangular depressions or shallow cells, with radiating lamellæ. In some species these cells are contiguous, in others they are separated by intervals. Many species are known only in a fossil state. It is in the cells of Astræa that the polypes reside; the mouth is rounded, and placed in a disc furnished sparingly with rather short tentacles, forming a single row.

Fig. 3819 represents the Astræa ananas. In this the cells are roundish and approximate, with distinct radiating lamellæ.

Fig. 3820, the Astræa rotulosa, found in the West Indian Seas. The star-like cells are distinct.

Fig. 3821, Astræa favosa, common in the East Indian Seas. The starry cells are contiguous.

The polypes are all united by a gelatinous expansion covering the calcareous coral. Many are very beautifully coloured, resembling green flowers with a deep blue disc.

In the genus Oculina the coral is fixed and branching, each branch being studded with elevated cells having internal calcareous radiations; the whole forming an elegant arborescent mass. The polypes do not appear to be known.

Fig. 3822 represents the Oculina axillaris. M. de Blainville distinguishes a tribe of Lithophytes or stony Zoantharia under the title of Madreporæa: the corals of this section are mostly arborescent, with the cells partially lamellated, the interstices being constantly porous. To these Madrepores belongs the genus Dentipora: this coral is arborescent, with deep, circular, elevated cells, each having ten internal dentiform lamellæ. The polypes are unknown.

Fig. 3823 represents Dentipora virginea: *a*, a portion, magnified; *b*, a section of one of the lamellated cells, magnified.

Another remarkable genus is Gemmipora. In this form the calcareous axis is arborescent or laminiform, fixed, and of a porous structure; the cells are deep, cylindrical, and somewhat lamellated within; their edges are elevated. The animals are destitute of tentacles. Fig. 3824 represents Gemmipora mesenterina, diminished: *a*, a portion, of the natural size.

In the genus Madrepora the calcareous axis is arborescent and very porous; the branches and expansions are crowded with small elevated cells, giving them a roughened appearance. The minute multitudinous polypes have twelve simple tentacles. There are several fossil as well as recent species described.

Fig. 3825 represents Madrepora abrotanoïdes, diminished: *a*, the termination of one of the branches, of the natural size.

The genus Palmipora presents us with branched forms of coral, but the branches end palmate or digitated; and the cells are small, scattered, and not elevated. The branched mass is fixed, and of a porous structure, being externally reticulated: animals unknown. Fig. 3826 represents Palmipora alcicornis (Millipora alcicornis, Linn.).

In the genus Heliopora the fixed calcareous polypary is of an irregular form and of porous structure; the cells are cylindrical, not elevated, and partially lamellated internally. The polypes are short, with a coronet of fifteen or sixteen tentacles.

Fig. 3827 represents Heliopora cærulea (Pocillopora cærulea, Lamarck), from the equatorial seas.

In Alveopora the cells are deep, polygonal, irregular, with perforated or reticulated walls; the mass is of porous structure. The polypes have twelve simple tentacula. Fig. 3828 represents Alveopora retepora.

In the genus Porites the polypary is fixed and rudely branched or diversiform, and of porous texture. The cells are polygonal, unequal, and incompletely radiated. The polypes have twelve short tentacles.

Fig. 3829 represents Porites clavaria, with club-shaped branches.

Fig. 3830 represents the polypes of Cladocora cespitosa, showing the mouth and the disc, surrounded by short tentacles. The lower figure is of the natural size.

We may now pass to a family termed Milleporidæ, which is thus described by M. de Blainville:—The polypes are in general very slender, and provided with a single circle of slender tentacles; the cells are often of considerable size, but always without lamellæ or striæ, within or without the tubes. The polypary is fixed and varies in shape. Removing from this family the palmated kinds to form the genus Palmipora among the Madrephylliæa, M. de Blainville still enumerates twenty-three genera, arranged in groups according to the characters of the cells. Numerous species exist only in a fossil state, in the transition and carboniferous strata.

In Favosites the cells are polygonal, prismatic, contiguous, vertical, or diverging; the walls of each cell are pierced with, and the inside is divided by, transverse septa: the polypary is either branched or massive. Ehrenberg places this genus near Astræa. The species known are all fossil. Fig. 3831 represents Favosites Gothlandica, Goldfuss: *a* and *b*, two specimens; *c*, nuclei of the tubes; *d*, tubes, magnified: *e*, portion of a vertical section.

Another genus, also fossil, is termed Terebellaria. It is branched, with small oval cells arranged in quincunx order on the surface of the polypary.

Fig. 3832 represents a beautiful species, Terebellaria ramosissima, found in the oolite of Caen, and also near Bath.

Another form, in which the cells are rounded and poriform, is represented by Stromatopora, of which the Stromatopora subconcentrica, Fig. 3833, is found in the transition limestone. The polypary is hemispherical, formed alternately of solid and porous layers, superimposed upon each other. Referring to Fig. 3833: *a*, shows the surface of a mass, reduced: *b*, a vertical section, reduced; *c*, a portion highly magnified.

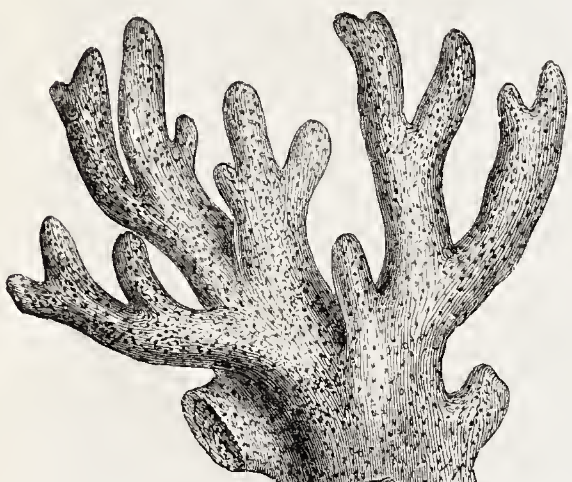
The genus Heteropora presents us with fossil species of a branched character, in which the cells, of different sizes, some large and some small, are dispersed over the whole surface. Fig. 3834 represents the Heteropora cryptopora, from the chalk of Maestricht.

We shall conclude this sketch of the Milleporidæ with the genus Hornera, of which there are both recent and fossil species. The polypary is fragile and branched, and the cells, which are prominent and arranged nearly in quincunx order, are disposed over the inner face of the branches, the opposite face being furrowed. The polypes have not been observed. Fig. 3835 represents the Hornera frondiculata: *a*, the natural size; *b*, the upper; *c*, the lower surface of a branch, magnified.

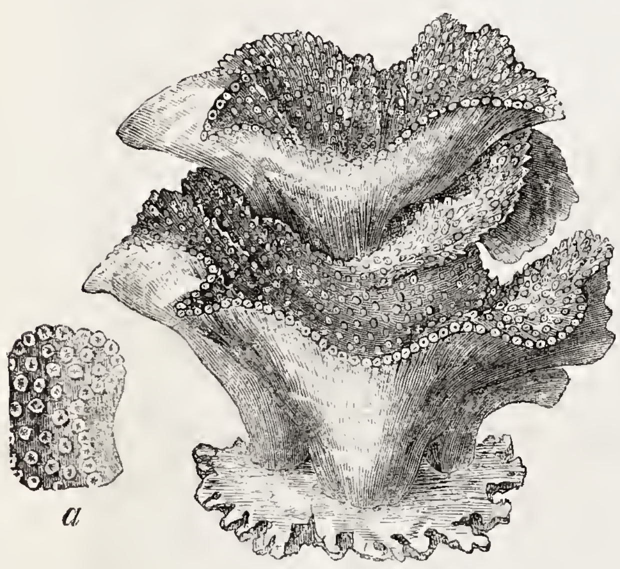
Before leaving these stony corals, it may not be out of place to give a brief attention to coral reefs and islands, respecting which so much has been said by voyagers in the Southern Ocean. And here we must refer to Mr. Darwin's admirable work, in which he gives the results of his own personal observations. Among the Coral islands, consisting of rings encircling a lagoon, may be noticed the Keeling or Cocos islands, about six hundred miles from the coast of Sumatra: one of these, Whitsunday Island, says Mr. Darwin, will serve to give an excellent idea of the general appearance of an annular Coral island, encircling a placid lagoon, and covered with cocoa-nut trees, which in process of time have clothed what was once a bare and water-washed reef. With reference to Keeling Island he says, "The annular reef of this lagoon island is surmounted, in the greater part of its length, by linear islets. On the northern or leeward side there is an opening through which vessels reach the anchorage. On entering, the scene was very curious and rather pretty; its beauty, however, being solely dependent on the surrounding colours. The shallow, clear, and still water of the lagoon, resting in its greater part on white sand, is, when illuminated by a vertical sun, of a most vivid green. This brilliant expanse, several miles in width, is on all sides divided, either from the dark heaving water of the ocean by a line of snow-white breakers, or from the blue vault of heaven by strips of land crowned at an equal height by the tops of the cocoa-nut trees. As a white cloud here and there affords a pleasing contrast with the azure sky, so in the lagoon dark bands of living coral appear through the emerald-green water." Such is the picture of a coral island, to which the waves drift the germs of a tropical flora, to which sea-birds repair, and build uninterrupted for centuries, till man arrives and claims it as his own.

Besides low annular islands encircling a lagoon, there are reefs of coral encircling islands, at various distances from the shore, such, for instance, as that of Vanikoro, where La Perouse was shipwrecked. "The reef runs there at the distance of two and, in some parts, three miles from the shore, and is separated from it by a channel, leaving a general depth of between thirty and forty fathoms, and in one part no less than fifty, or three hundred feet. Externally the reef rises from an ocean profoundly deep."

3823.—Dentipora virginea.

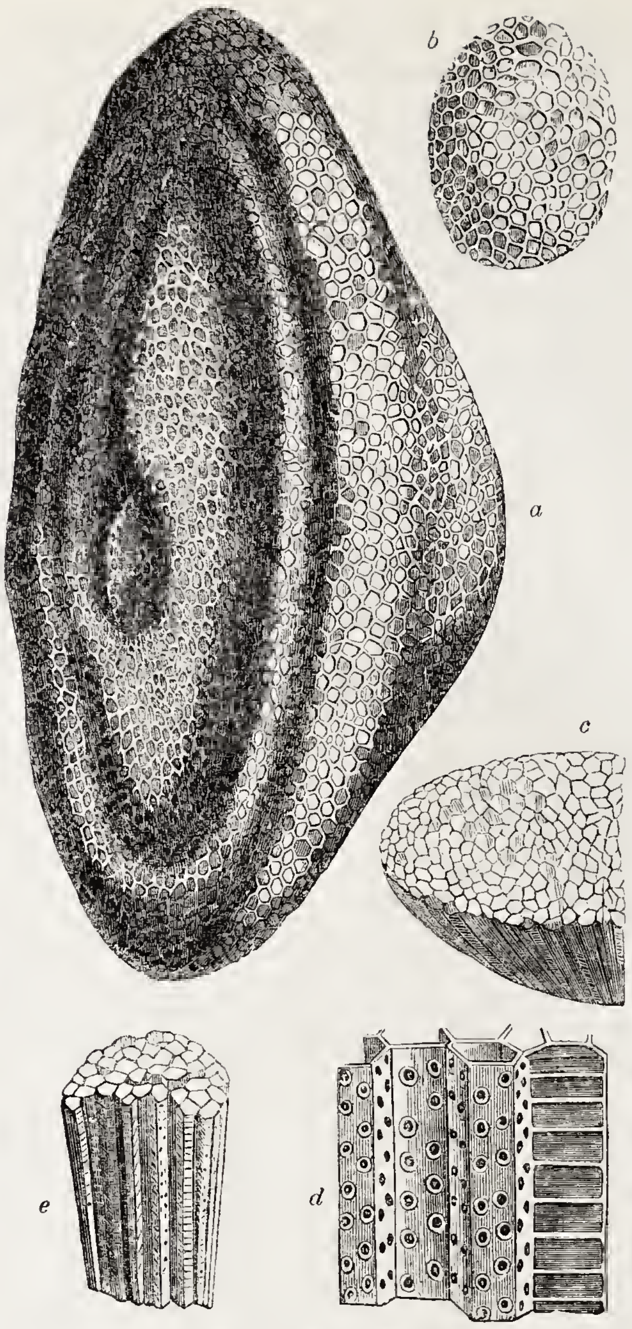


3826.—Palmipora alcicornis.

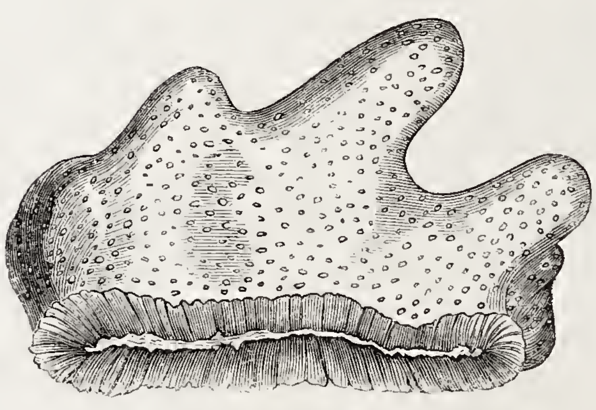


3824.—Gemmipora mesenterina.

3830.—Animal of Cladocora cespitosa.

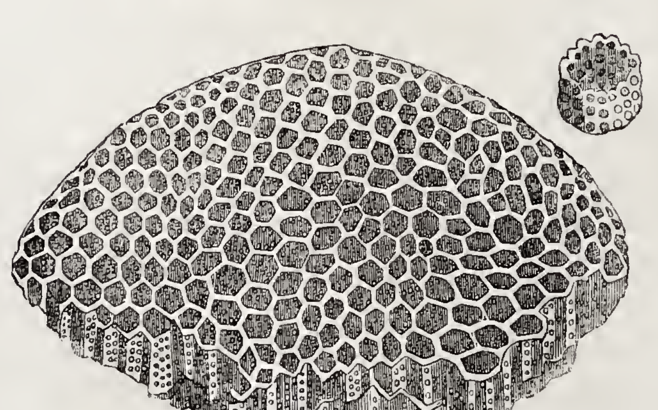


3831.—Favosites Gothlandica.

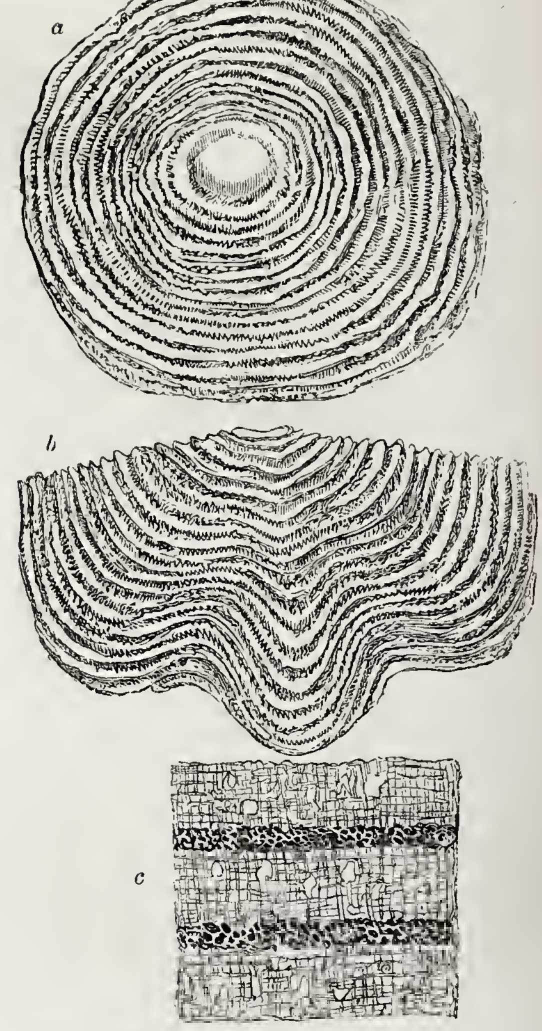


3827.—Heliopora cærulea.

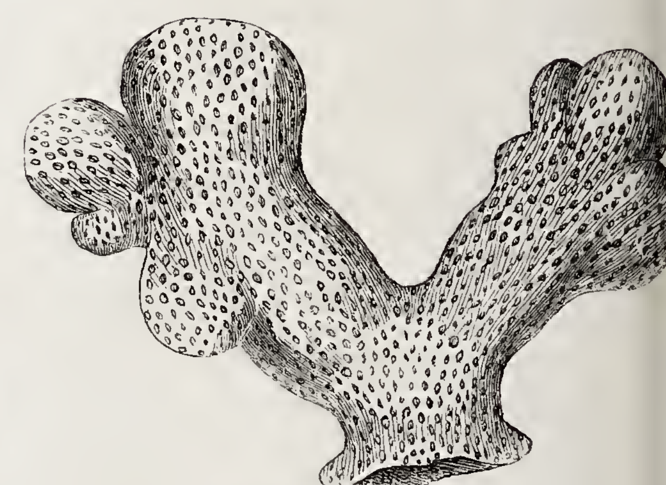
3832.—Terebellaria ramosissima.



3828.—Alveopora retepora.



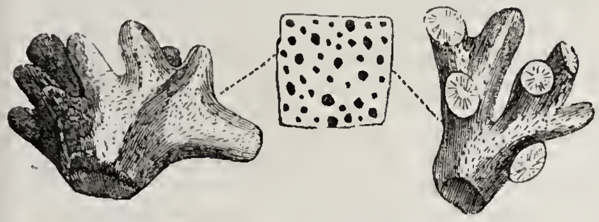
3833.—Stromatopora subconcentrica.



3829.—Porites clavaria.

3825.—Madrepora abrotanoides.

3843.—Campanularia volubilis.



3834.—Heteropora cryptopora.

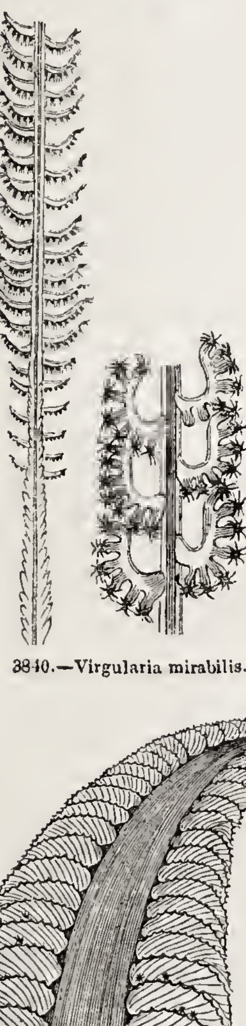
3844.—Plumularia pluma.

3836.—Red Coarl.

3838.—Primnoa lepadifera.

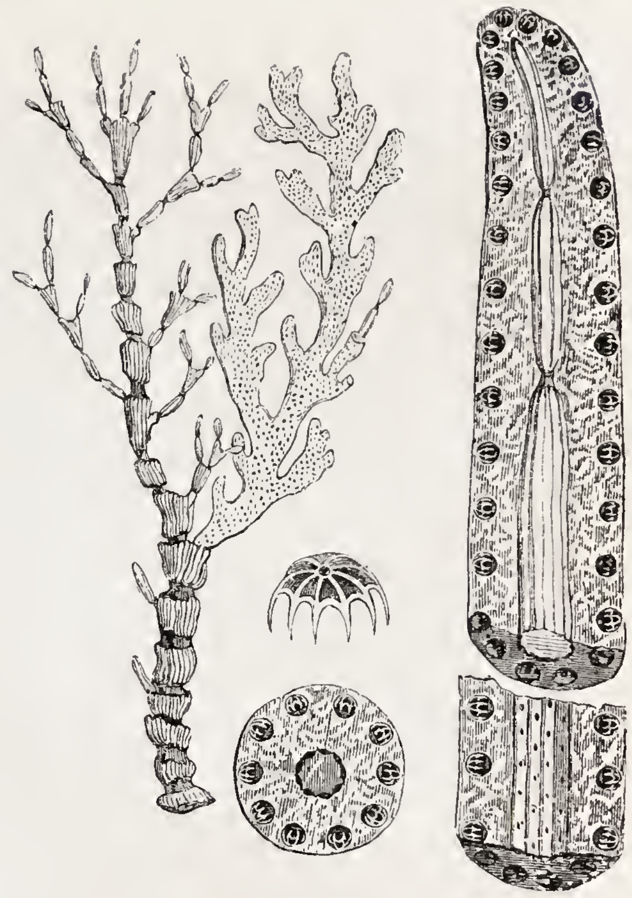
3842.—Tibiana fasciculata.

3839.—Umbellularia encrinus.

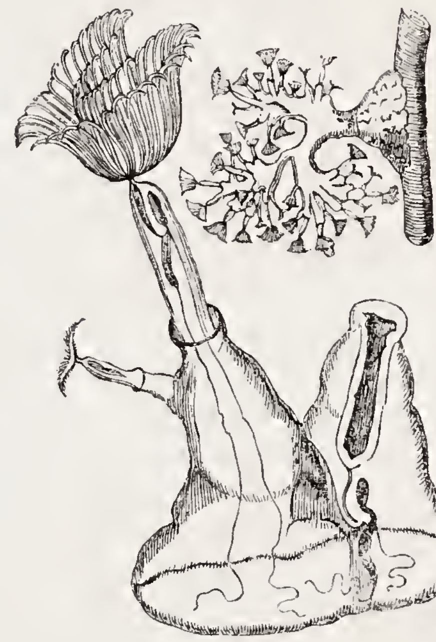


3840.—Virgularia mirabilis.

3841.—Pennatula grisea.

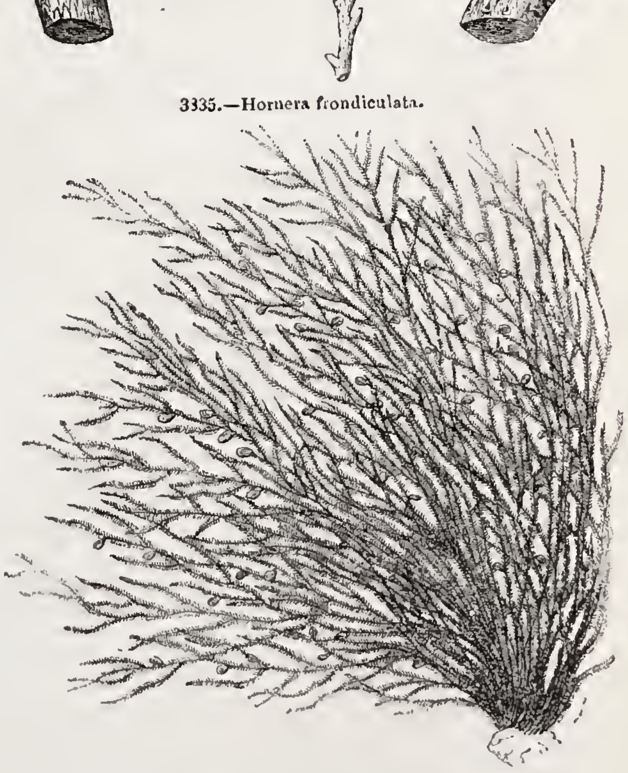


3837.—Horsetail Coral.



3846.—Plumatella cristata.

3835.—Hornera frondiculata.



3845.—Dynamena operculata.

Sometimes reefs rather fringe than encircle islands; and sometimes vast reefs form barriers running for miles parallel to a coast. Such is the great barrier described by Flinders as fronting the north-east coast of Australia, having a length of nearly a thousand miles: it runs parallel to the shore, at a distance of twenty, thirty, and in some fifty and even seventy miles; and the arm of the sea between it and the shore varies from ten to twenty fathoms in depth, this increasing sat one end to forty and even sixty. In reference to Keeling Island, Mr. Darwin writes, "I am glad we have visited these islands; such formations surely rank high amongst the wonderful objects of this world. It is not a wonder which first strikes the eye of the body, but rather, after reflection, the eye of reason. We feel surprised when travellers relate accounts of the extent of certain ancient ruins; but how utterly insignificant are the greatest of these when compared to the pile of stone here accumulated by the work of various minute animals. Throughout the whole group of islands every single atom (excluding earth subsequently brought in vessels from Malacca and Java), even from the smallest particle to large fragments of rock, bears the stamp of having been subjected to the power of organic arrangement. Captain Fitzroy, at the distance of little more than a mile from the shore, sounded with a line 7200 feet long, and found no bottom. This island is therefore a lofty submarine mountain, which has a greater inclination than even those of volcanic origin on the land." Now as the lamelliform coral polypes, to the untiring labours of which these islands, circular reefs, and vast barriers are due, cannot exist at a great depth, and indeed on the contrary, as was proved by Mr. Darwin, cease to exist at a short distance below ten fathoms, and prefer a less depth, where they feel the influence of the light and warmth of the sun, it becomes a question under what circumstances these vast masses, these reefs, these belts, these islands, have been deposited, and which are incontestably coral in their structure.

"As long," says Mr. Darwin, "as no facts beyond those relating to the structure of lagoon islands were known, so as to establish some more comprehensive theory, the belief that corals constructed their habitations, or, speaking more correctly, their skeletons, on the circular crests of submarine craters, was both ingenious and very plausible. Yet the sinuous margin of some, as in the Radack Islands of Kotzebue, one of which is fifty-two miles long by twenty broad, and the narrowness of others, as in Bow Island (of which there is a chart on a large scale, forming part of the admirable labours of Captain Beechey), must have startled every one who considered this subject." Indeed, where reefs encircle islands, as in the case of Tahiti, we cannot suppose them based on the sides of a crater; and in the instance of lagoon islands, on the volcanic theory, we ought to find the lagoon of tremendous depth. We consider that the theory of subsidence renders the whole operation clear, and here we must quote the words of Mr. Darwin, whose admirable elucidation of this subject we earnestly recommend to the attention of our readers. "The theory is simply, that as the land with the attached reefs subsides very gradually, from the action of subterranean causes, the coral-building polypi soon raise again their solid masses to the level of the water; but not so with the land, each inch lost is irreclaimably gone; as the whole gradually sinks, the water gains foot by foot on the shore, till the last and highest peak is finally submerged.

"Before I explain this view more in detail, I must enter on a few considerations which render such changes of level not improbable. Indeed, the simple fact of a large portion of the continent of South America still rising under our eyes, and abounding with proofs of similar elevations on a grander scale during the recent period, takes away any excessive improbability of a movement similar in kind, but in an opposite direction. Mr. Lyell, who first suggested the idea of a general subsidence with reference to coral reefs, has remarked that the existence of so small a portion of land in the Pacific, where so many causes, both aqueous and igneous, tend to its production, renders such sinking of the foundation probable. There is, however, another argument of much greater weight, which may be inferred from the inconsiderable depth at which corals grow. We see large extents of ocean, of more than a thousand miles in one direction, and several hundred in another, scattered over with islands, none of which rise to a greater height than that to which waves can throw fragments or the wind heap up sand. Now, if we leave out of the question subsidence, the foundation on which these reefs are built must in every case come to the surface, within that small limit (we may say twenty fathoms) at which corals can live. This conclusion is so extremely improbable, that it may at once be rejected; for in what country can there be found a broad and grand range of mountains of the same height within one hundred and twenty feet? But on the idea of subsidence the case is at once clear. As each point, one after another, according to its altitude, was submerged, the coral grew upwards, and formed the many islets now standing at one level.

"Having endeavoured on general grounds not only to remove any extreme degree of improbability in the belief of a general subsidence, but likewise to show that it is almost necessary to account for the existence of a vast number of reefs on one level, we will see how far the same idea will apply to the peculiar configuration in the several classes. Let us imagine an island merely fringed by reefs extending to a short distance from the shore; in which case, as we have before remarked, there is no difficulty in understanding their structure. Now, let this island subside by a series of movements of extreme slowness, the coral at each interval growing up to the surface. Without the aid of sections it is not easy to follow out the result; but a little reflection will show that a reef encircling the shore at a greater or less distance, according to the amount of subsidence, would be produced. If we suppose the sinking to continue, the encircled island must, by the submergence of the central land, but upward growth of the ring of coral, be converted into a lagoon island. If we take a section of some encircled island on a true scale, as for instance, Gambier, which has been so well described by Captain Beechey, we shall not find the amount of movement very great which would necessarily change a well-characterised encircling reef into as characteristic a lagoon island.

"It may be said, granting the theory of subsidence, a mere circular disc of coral would be formed, and not a cup-shaped mass. In the first place, even in reefs closely fringing the land, the corals do not grow on the shore itself, but leave a shallow channel; secondly, the strong and vigorous species, which alone build a solid reef, are never found within the lagoon, they only flourish amidst the foam of the never-tiring breakers. Nevertheless, the more delicate corals, though checked by several causes, such as strong tides and deposits of sand, do constantly tend to fill up the lagoon; but the process must become slower and slower, as the water in the shallow expanse is rendered subject to accidental impurities. A curious instance of this happened at Keeling Island, where a heavy tropical storm of rain killed nearly all the fish. When the coral at last has filled up the lagoon to the height of lowest water at spring-tides, which is the extreme limit possible, how afterwards is the work to be completed? There is no high land whence sediment can be poured down; and the dark blue colour of the ocean bespeaks its purity. The wind carrying calcareous dust from the outer coast is the only agent which can finally convert the lagoon island into solid land, and how slow must this process be!"

With respect to an enormous reef skirting a continent it is easy to conceive how a depression of the shores of that continent, continued slowly, will give rise to an elevated mass of coral, the myriads of beings working upwards, to maintain the proper degree of depth, while the channel between the reef and the coast will be gradually made wider and deeper. In this way may we account for the formation of the vast coral-bank skirting the north-east of Australia, and running parallel to the coast.

We have not room to follow Mr. Darwin through all his arguments or enter into all his observations; suffice it to say that the very facts adduced to prove elevation often prove the contrary, though at the same time it must be conceded that many lagoon islands, originally the result of subsidence, may have again been more or less elevated, and that in latitudes where subterranean forces are active, alternate and irregular, movements of subsidence and elevation are quite to be expected; especially when "the space lies directly between the well marked area of elevation and the enormous one of subsidence." Moreover, there are coral reefs which show no trace of subsidence, but prove a recent elevation of the bed of the sea, on which the coral polypes have established themselves; where the shallow depth of the water favoured their operations. Mr. Darwin sums up his interesting observations as follows: "in the first place reefs are formed around islands or on the coast of the mainland, at that limited depth at which the efficient classes of Zoophytes can live; and where the sea is shallow, irregular patches may likewise be produced; afterwards, from the effects of a series of smaller subsidences, encircling reefs, grand barriers, or lagoon islands are mere modifications of one necessary result. Secondly, it can be shown on the above views, that the intertropical ocean throughout more than a hemisphere may be divided into linear and parallel bands, of which the alternate ones have undergone within a recent period the opposite movements of elevation and subsidence. Thirdly, that the points of eruption seem invariably to fall within areas subject to a propulsion from below. The traveller who is an eye-witness of some great and overwhelming earthquake, at one moment of time loses all former associations of the land being the type of solidity! so will the geologist, if he believe in these oscillations of level (the deeply seated origin of which is betrayed by their forms and vast dimensions), perhaps be more deeply impressed with the never-ceasing mutability of the crust of this our world." Such then are the labours of the coral polypes.

> "Unconscious, not unworthy instruments,
> By which a hand invisible was rearing
> A new creation in the secret deep.
> Omnipotence wrought in them, with them, by them;
> Hence what Omnipotence alone could do
> Worms did. I saw the living pile ascend
> The mausoleum of its architects,
> Still dying upwards as their labours closed.
> Slime the material, but the slime was turned
> To adamant by their petrific touch.
> Frail were their frames, ephemeral their lives;
> Their masonry imperishable."—MONTGOMERY.

Many coral polypes are acrid, and have the property of stinging. Such are noticed by M. Quoy; and Mr. Darwin found two species of Millepora which had this power when taken fresh from the water, and he says, that on merely touching his face with a branch, on one occasion he felt sharp and instantaneous pain. The same writer observed two species of fish (sparus) which exclusively feed on coral: both are of a splendid bluish green, but one invariably lives in the lagoon, the other in the outer breakers. Mr. Liesk assured him that he had seen repeatedly whole shoals of these fish grazing with their strong bony jaws on the tops of the coral branches. It has been sometimes thought that coral-eating fish were poisonous, but such was not the case with the sparus in question.

Let us now turn to the corticiferous Polypifera, a group of which the red coral of commerce may be taken as a type. Ramified and arborescent from a fixed base, these Polypiaria present us with an external living fleshy envelope, bearing and containing polypes, and an internal firm inorganic axis or framework, calcareous, or horny, or both in alternate joints. There are no cells or tubes in the axis or skeleton, but polype cells are scattered over the living fleshy envelope, into which the polypes can retire.

The red coral of commerce (Corallium rubrum), Fig. 3836, is found in the Mediterranean and the Red Sea. It grows arborescent, attached to stones, rocks, fragments of lava, and various hard substances at the bottom of the water. Its axis is of a beautiful red, and of sufficient hardness and closeness of texture to take a fine polish. In its natural state it is covered with a whitish rind, united to the axis by a reticulated membrane abounding with milky follicles; on the surface of the fleshy rind are thinly scattered tubercles with a cavity or cell in which a milk-white and almost transparent polype is lodged, having the mouth surrounded by eight conical tentacles. This fleshy rind becomes friable and chalky when dried.

Unlike the Madrepores, Red coral is of slow growth, and at a moderate depth requires eight or ten years to grow to the height of a foot, which it seldom surpasses. When full grown it increases slowly in circumference, and the living rind dies at length, leaving its axis to the attacks of various minute boring animals, which soon pierce it in all directions and cause its destruction.

The depth at which coral grows varies from six or seven fathoms to sixty or a hundred; seldom much deeper: it is said to prefer along the French coast the surface of rocks inclining to the south, and in the Straits of Messina those with an eastern aspect. In these straits, where the heat of the sun penetrates very deeply into the water, the coral is found even below a hundred fathoms, but of inferior quality. It would appear indeed that its ratio both of growth and quality depends upon the depth (and consequent influence of light and warmth) at which it exists; and the most beautiful is that obtained in shallow water, permeated as it were by the rays of the sun. To acquire a determinate height, say one foot, coral requires eight years in water varying from five to ten fathoms, ten years in water from ten to fifteen fathoms, and from twenty-five to thirty years in water of the depth of a hundred fathoms. It is said that fifteen varieties of coral are distinguished in commerce according to their degrees of hardness and brilliancy of colour: that procured off the coast from France is in the highest esteem, as is that also from the Italian seas. On the African shores of the Mediterranean the colour is less brilliant, and though the branches are thicker, their texture is less compact.

Coral fisheries are established in many parts of the Mediterranean. It would appear that the ground is divided into separate portions, one of which is dragged only once every ten years, in order to allow of the growth of a fresh crop of coral. The apparatus for dragging it is very rude, and consists of a

large cross of wood with a heavy weight in the centre, and nets properly secured to each limb; this is let down from a boat by means of a rope duly secured; the boat is then rowed over the coral beds, and the stems and branches are broken off by the machine and entangled in the nets. It is thus that the coral fishery off Trepani in Sicily is carried on, and also on the Barbary coast, where, however, they do not drag for it beyond three or four leagues from shore, and in water not deeper than fifteen or twenty fathoms. This method of collecting it is very rude, and no doubt much is lost.

"In all ages and countries," says Lamouroux, "men have acknowledged the beauty of coral. Warriors have employed it in the decoration of their arms, and women in that of their dress. The physicians of the middle ages looked upon it as a universal remedy; and the priests of ancient religions as an object acceptable to the gods." In the present day the value of coral is very far less than what it was formerly.

To the present group Corticifera, family Corallidæ, belongs the genus Isis. In this genus the axis is arborescent, and composed of alternate joints of white calcareous and dark horny matter, or rather of a calcareous stem and branches, separated into articulations by horny intervals of greater or less extent. The calcareous joints are longitudinally striated. The whole is covered with a thick fleshy integument in which the polype-cells are abundantly scattered. The polypes are minute. Fixed to the rock, these jointed corals yield to the rolling waves or currents of the water. Fig. 3837 represents the Isis hippuris, or Horsetail coral: a portion is denuded to show the joints, and one branch is covered with its living investment studded with polype-cells; the right-hand figure is the section of a portion showing the axis, and the thick fleshy rind, with its polype-cells displayed, and polypes contracted within; a single polype is also figured; and a transverse section of the stem.

Among those genera in which the axis is entirely horn-like and elastic, we may notice Gorgonia, of which some species resemble bending osiers, and others present the form of reticulated fans; Antipathes, with branching stems, reticulated expansions, or feather-like ramifications; Plexaura; and Primnoa. With respect to the latter, it is characterised by Lamouroux as tree-formed and dichotomous; the polypes covering the axis, which is hard and horny, in the form of long pyriform bodies with imbricated scales, serving as polype-cells. The tentacles of the prominent polypes are conical, and in repose fold over the mouth. One species only is known, Primnoa lepadifera, from the Norway coast. A branch of this coral is represented at Fig. 3838, with the polype distinct in two views. The entire zoophyte is from six to ten or twelve inches in height.

Another family of the Corticifera is termed Pennatulidæ.

The Pennatulidæ, as characterised by M. de Blainville, are polypiform, provided with eight pinnated tentacles and regularly scattered on one part of the surface of the general subtance. The form of the whole is determinate. The mass is composed of a central and solid axis surrounded by a fleshy cortical substance, often very thick, and supported by calcareous minute needles more or less numerous.

All or nearly all are unattached, and float in the waters of the sea. Many are phosphorescent.

Whatever may be the general form of the Pennatulidæ, one of the extremities is always devoid of polypes, and this part, more or less elongated, has been compared to the quill of a feather, while the polypiferous portion resembles expanded barbs. These zoophytes have in fact a bilateral symmetry of which other groups show us no similar examples.

In the genus Umbellularia the polypes, which are elongated, with eight strongly pinnated tentacles, are arranged so as to form an umbel at the end of a long tetragonal cortical mass, which contains a tetragonal calcareous axis. Fig. 3839 represents Umbellularia encrinus, from the Greenland Seas; a portion of the stem is laid open to show the axis.

In Virgularia there is a long central stem, with regular lateral fleshy branches, on which the polypes with ciliated tentacles are arranged in rows. Fig. 3840 represents the Virgularia mirabilis (Pennatula mirabilis, Müller). In Pennatula the general form is that of an expanded feather. The polypes, which are entirely retractile, and have eight ciliated tentacles, are irregularly disposed on the retral edge of lateral pinnules, or barbs, symmetrically placed along each side of the central stem with a simple calcareous axis; and these pinnules are prolonged into a bulbiform expansion pierced by four terminal openings. Fig. 3841 represents Pennatula grisea. In the warmer parts of the ocean, numbers of Pennatulæ, or Sea-pens, may be observed floating. Cuvier says that they can propel themselves by the contraction and dilatation of the fleshy investment of their simple calcareous axis, and the simultaneous action of the tentacles of the polypes. This, however, has been denied by subsequent observers, who assert that they are completely passive, being merely carried along like sea-weed by the current.

Mr. Darwin observed at Bahia Blanca hundreds of a species of Virgularia (V. Patachonica) projecting at low water from the muddy sand. When touched or pulled, they draw themselves in suddenly and with force, so as nearly or quite to disappear. By this action, he observes, the highly elastic axis must be bent at the lower extremity, where it is naturally slightly curved, and he considers that it is by this elasticity that the zoophyte is enabled to rise again through the mud. The stem varied in length from eight inches to two feet, and had alternate rows of polypes on each side.

The reproduction of the Corticiferous Polypiaria is from germs which are developed on internal convolute membranes, and which when mature escape through the common orifice of the polype, or in some manner not clearly ascertained.

Let us now pass on to the compound tubular Polypifera, the "Polypes à Tuyaux" of Cuvier, in part the Nudibranchiata of Dr. Farre, which in general aspect agree with the Bryozoa already noticed, and with which till recently they have been associated. The polypes, however, are far less complex in structure, being simply hydriform; yet it must be confessed that further observations are necessary before the strict boundary-line between the Bryozoa and the simpler tubular polypes can be rigidly laid down. Perhaps, indeed, in a popular work like the present it would be allowable to throw them together; yet in so doing we should not treat our subject with proper accuracy. This difficulty appears to have been felt by Professor Jones, who in his valuable 'Outline of the Animal Kingdom' speaking of the "Polypes à Tuyaux" says that the group "would seem indeed to comprise animals distinguished from each other by so many important circumstances, and yet so intimately related by external configuration, that it is difficult to separate them or leave them in the same group." We have ventured to separate them; and that on the grounds of organization. "In the uniciliated tubular polypes the common body of the animal, instead of encrusting a solid skeleton, is enclosed in a horny sheath, which it traverses like the pith of a tree, following all the ramifications of the branched stem of the polypary: to the central part are attracted at intervals cells opening externally, in which the polypes, which provide nourishment for the whole, are lodged." These characters attach to the Bryozoa; but their structure, as we have said, is far more complex.

Of graceful form, the uniciliated tubular polypes cannot but attract observation; they abound on our own shores and specimens may be procured with little difficulty; the very tide carries many to our feet. These delicate arborescent zoophytes are for the most part phosphorescent. Mr. A. H. Hassall ('Ann. and Mag. of Nat. Hist.' June, 1841) states that he has ascertained that all the more transparent zoophytes possess highly luminous properties. This fact he first discovered in a specimen of Laomedia gelatinosa, one of the Tubulariæ, and subsequently in a great variety of other species.

"Imagination," he adds, "can scarcely conceive a more beautiful spectacle than would be furnished by the shining of countless myriads of these tiny lamps lighting up the dark recesses and caves of the ocean." "I had lately (he continues) an opportunity of beholding this novel and interesting sight of the phosphorescence of zoophytes to great advantage, when in one of the Devonshire trawling-boats which frequent this coast (Ireland). The trawl was raised at midnight, and great quantities of corallines were entangled in the meshes of the network, all shining like myriads of the brightest diamonds."

The numerous genera into which these elegant zoophytes with flexible stems and branches enclosing a living thread are divided, range themselves under two families—Tubulariæ, and Sertulariæ. In the former we are presented with simple or branched horny tubes, from the open extremities or branches of which the polypes emerge and expand their tentacles. One species, the Tubularia indivisa, found on our shores, resembles a portion of straw two or three inches in length, from the orifice of which protrude the polype, with two circlets of tentacles, one immediately surrounding the mouth, the other circlet lower down near a second aperture or mouth communicating with the body enclosed within the tube.

Another form is presented by Tibiana, of which Fig. 3842 shows the Tibiana fasciculata. In this species the tube assumes a series of angular flexures, each angle having an orifice for the protrusion of the polype. The tube is about as thick as a knitting-needle, and numbers rise clustered together from a common base. They are found in the Indian and Australasian Seas.

In the family Sertulariæ we are generally presented with beautiful frondescent zoophytes, the stem and branches being slender, horny, and apparently jointed at regular intervals, each joint being merely a break in the continuity of the sheath, occasioned by periodical interruptions in its growth. At the extremities, or along the sides of the branches, are the cup-like cells of the polypes arranged in a definite order: in some the cups are sessile, that is, closely resting on the branch; in others they are elevated on a stalk. In some species of the genus Campanularia the zoophyte gracefully twines around others capable of supporting it, as the ivy round the oak, and sends up branches crowned with a bell-like polype cell having an indented margin. Fig. 3843 represents the Campanularia volubilis, of the natural size and magnified.

In Thuiaria the cells are sessile and occupy each side of the branches, alternating with each other.

In Sertularia the cells are also sessile, and arranged alternately or in pairs on the stem and branches of the delicate frondescent polypary.

In Plumularia (Aglaophenia, Lamour.) the cells are arranged on one side of the small branches of horny articulated penniform polypary. In these genera the polypary is fixed to shells or stones by several tubular radical fibres. Fig. 3844 represents Plumularia pluma (Sertularia pluma, Linn.).

In Dynamena the cells are serrated, sessile, and arranged in pairs regularly opposite, along the branches and stem of a horny articulated plant-like polypary. Fig. 3845 represents the Dynamena operculata, from the European seas. It is attached to stones by creeping radical fibres.

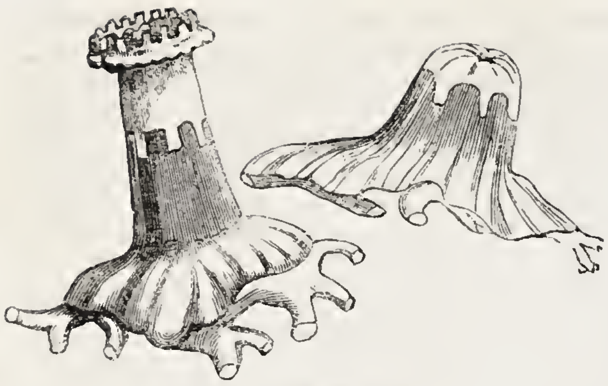
In a group termed Polypiaria dubia by M. de Blainville are arranged several forms belonging to the Zoophyta Hydroïda of Dr. Johnston, of which one is the Plumatella. It seems probable that this genus should be referred to the Bryozoa, with Cristatella and Alcyonella, &c.

The genus Plumatella (Naïsa, Lamour.) comprises several fresh-water species, usually found in clear running streams, attached to the under surface of the leaves of aquatic plants, as Nymphæa, or to stones in obscure recesses. The polypary is fixed with a slender membranous stem, frequently ramified, and both stem and branches terminated by a polype capable of entire retraction within the polypary. The mouth of the polype is surrounded by tentacular cirrhi forming a horse-shoe figure. Fig. 3846 represents the Plumatella cristata (Naïsa reptans, Lamour.). It is found in fresh water, and the tubes are membranous, transparent, and branching, larger at the base than at the summit. We shall conclude this part of our subject with a few observations on the economy of the tubular horny zoophytes. In these singular beings, so often mistaken for sea-weed, as the Tubulariæ, Sertulariæ, &c., the tubes are formed by the hardening of the tegumentary membrane of the living pulp; hence we can easily conceive how it comes to pass that we so often find the stems and branches laden with vesicles larger than the cells (Figs. 3844, 3845). In these vesicles are developed the gemmules of a succeeding race. When mature they escape by a disruption of the top, or fall of the lid, and the vesicles soon after wither and disappear. It is thus that the Sertulariæ and the allied zoophytes are reproduced. The gemmules are provided with minute cilia; they row themselves about and ultimately fix upon a congenial site, throwing out root-like fibres after the manner of a plant. They then push up a shoot, the commencement of a future stem; polype-cells and polypes are evolved on its sides, branches are given off, and a cluster of polypes connected by a living thread constitutes a family, the objects and interests of which are identical, an inscrutable instinct regulating all their workings. The growth of these beautiful zoophytes is extremely rapid, and their duration often short. Some appear to have but a summer's existence, many are probably annual, and those which attach themselves to sea-weeds cannot prolong their duration beyond that of the frond upon which they are fixed. Those which are rooted upon rocks, stones, and shells are probably less perishable, and continue perhaps for several years to develop new branches and new polypes.

We may now turn to a higher order of zoophytes, viz., the Zoartharia of M. de Blainville, the Fleshy Polypes of some writers, the Zoophyta helianthoïda of Dr. Johnston, of which the Actiniæ, or Sea-Anemonies, are familiar examples.

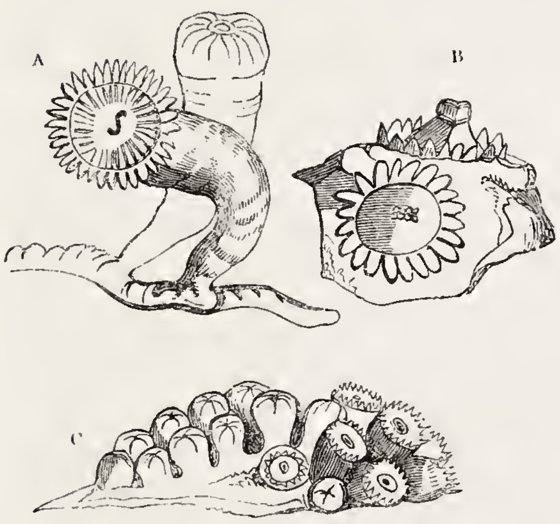
In these animals the body is regular, flower-shaped, more or less elongated, and very contractile, with a sac-shaped digestive apparatus, the oral orifice being surrounded by tentacles variously shaped and tubular; some are fixed, others are free.

In order to understand the general structure which prevails in this section, let us examine one of the Actiniæ, which are common on the tide-covered rocks of our coast or tenant the sandy shore.



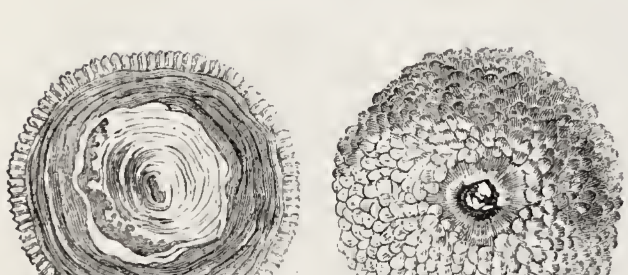
3858.—Capnea sanguinea.

3857.—Ilyanthus Scoticus.



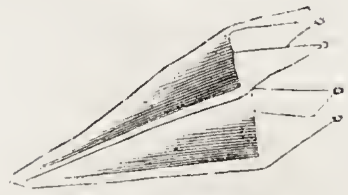
3859.—Zoanthidæ.

3862.—Leucophrys patula.

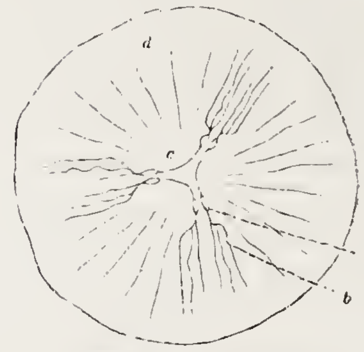


3845.—Actinia helianthus.

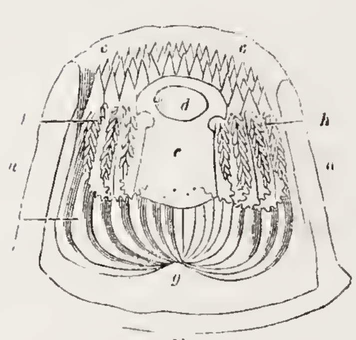
3854.—White Sea-Anemone.



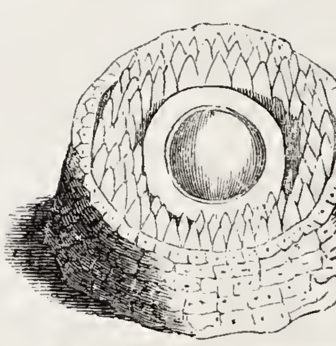
3850.—Muscles of Actinia.



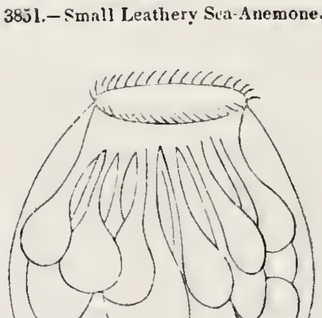
3849.—Nerves of Actinia.



3847.—Section of Actinia.

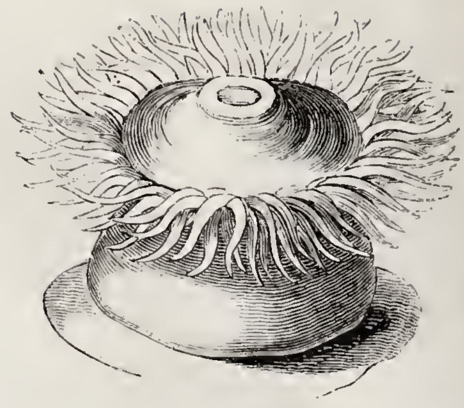


3851.—Small Leathery Sea-Anemone.

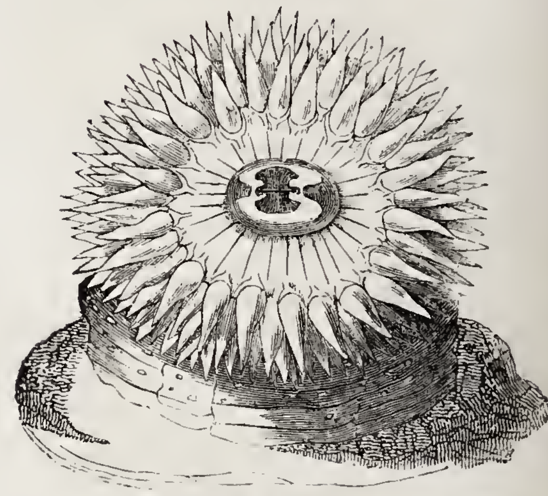


3861.—Monas atomos.

3848.—Ovaries of Actinia.

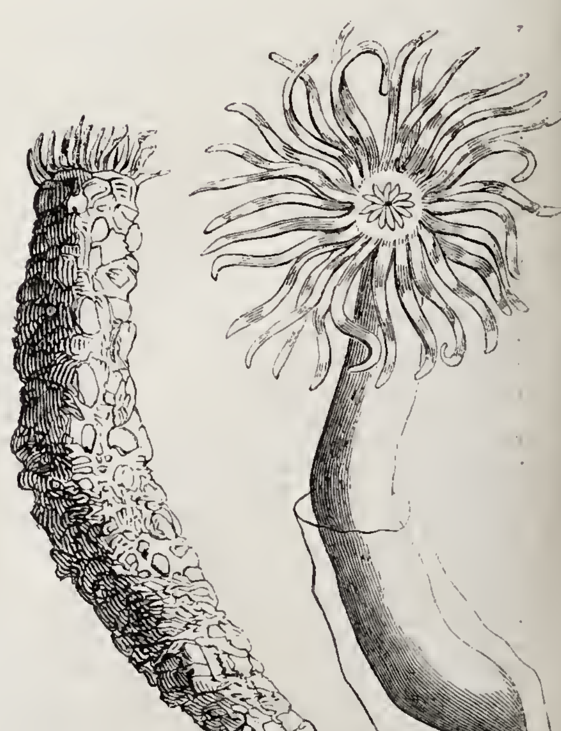


3853.—Purple Sea Anemone.

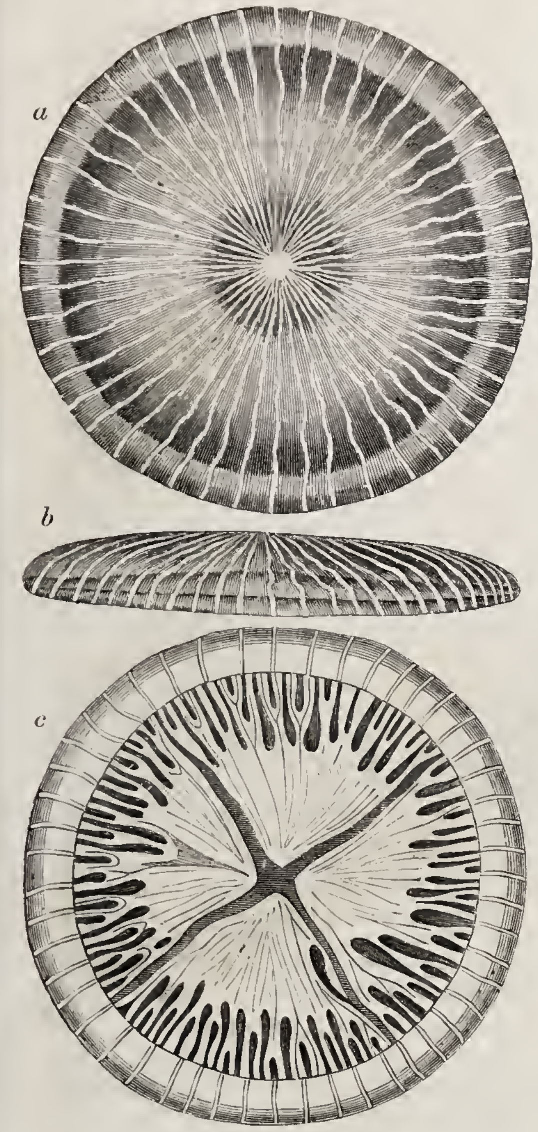


3852.—Large Leathery Sea-Anemone.

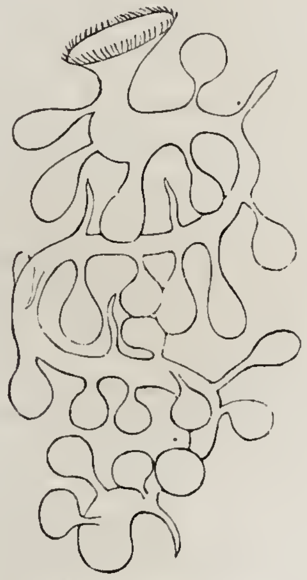
3860.—Lucernaria auricula.



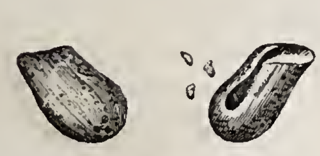
3856.—Edwardsia vestita.



3865.—Eudora undulosa.

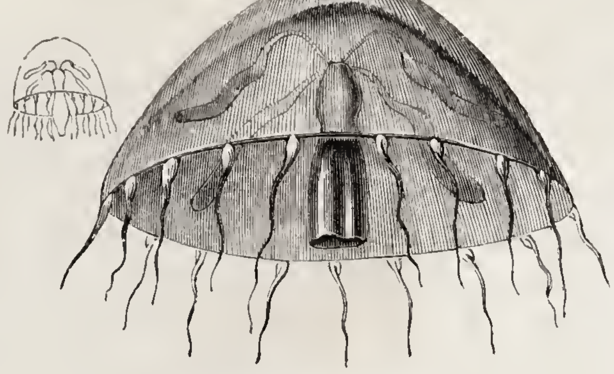


3863.—Leucophrys patula.



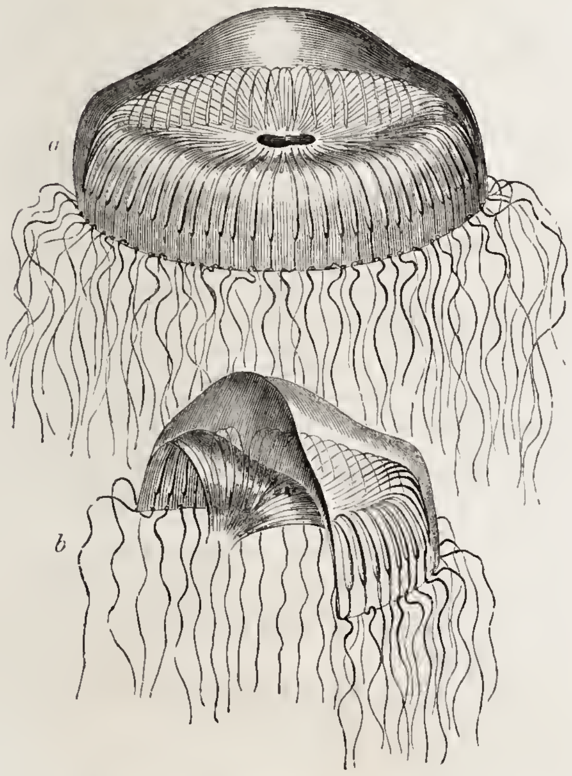
3864.—Bursaria truncatella.

3869.—Tima flavilabris.

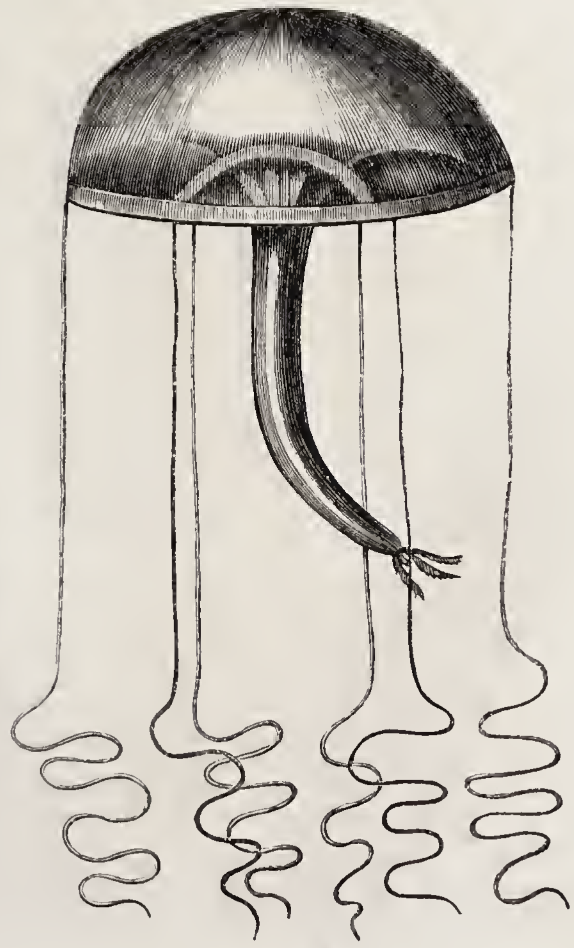


3868.—Thaumatias cymbaloidea.

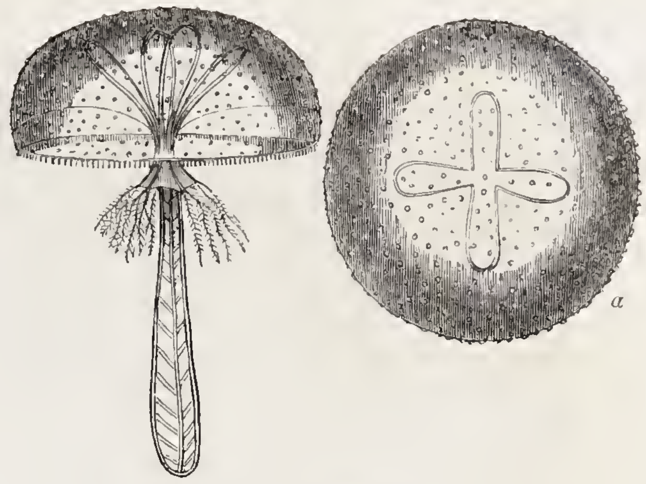
3866.—Charybdæa periphylla.



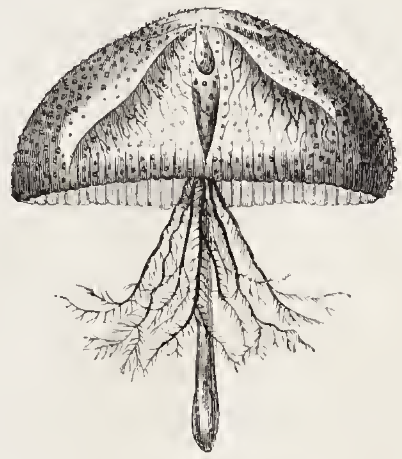
3867.—Æquorea cyanea.



3870.—Dianæa.



3872.—Lymnorea triedra



3871.—Favonia octonema.

3873.—Pelagia Labiche.

3875.—Rhizostoma Cuvieri.

The Actinia consists of a soft fleshy cylindrical body, with a base acting as a sucker, by means of which the animal adheres to rocks or pebbles, at least in many species. The opposite extremity presents a striated disc with a central oral orifice, and is surrounded by tentacles, either in a single row or in several rows, capable of being contracted, elongated, and moved in various directions; they are in fact the arms by which the animal seizes its prey and drags it to the mouth. When waiting for its prey, some mollusk or unfortunate little crab, these arms are expanded like the petals of a flower, and being tinted with brilliant colours present an elegant appearance.

At the base of the Actiniæ nervous fibres, it is asserted, have been detected diverging from several ganglia; and certainly on the outer skin of the body, which is covered by a mucous investment, both longitudinal and transverse muscular fibres are apparent. These fibres enable the animal to contract with great force, and assume the figure of a rounded mass, neither tentacles nor oral disc being apparent. The sensibility of these creatures is extreme; they contract even when a dark cloud passes over the sun, and we have seen the Actinia senilis, which lives in the sand, eject a quantity of water from its mouth and rapidly bury itself on our approach; yet so tenacious of life are these animals that they may be divided with impunity, and each part will become a distinct animal. When transversely cut asunder, the basal portion is about two months in gaining its tentacles.

The Actiniæ are extremely voracious, and seize and swallow animals with which they seem incapable of contending: they engulf crabs and shelled mollusks, and distend themselves with their prey, which their tentacles enfold and force into the mouth. The process of digestion is rapid, and the shells and harder parts of their victims are disgorged when the fleshy parts are consumed. Notwithstanding their voracity, still the Actiniæ are patient of hunger, and endure long abstinence without apparent inconvenience. They may be kept for a considerable length of time in a vessel of sea-water, if the water be daily changed; perhaps the animalcules with which it is replete afford some nutriment. It is interesting to watch them under these circumstances. We may observe them spreading abroad their richly coloured arms, and distending themselves with the water, till the oral disc swells out like a thin globule; but on the least alarm they eject the fluid, draw in their arms, and contract into a firm fleshy mass, which soon again unfolds, and spreads its rainbow-tinted arms in quest of prey.

With respect to the structure of these Actiniæ, the external tunic consists of muscular fibres intermingled with granular bodies, apparently of a glandular nature, everywhere distributed, excepting on the base. Over this musculo-glandular tissue is spread a mucous layer or epidermis, which appears to be frequently thrown off and renewed. The stomach consists of a plicated membranous sac with a papillous surface, into which the oral orifice immediately opens. A circular muscle surrounds the latter, and a similar muscle runs round the circumference of the disc, enabling the animal to draw the outer tunic over it when it contracts, so as to shroud itself entirely. The tentacles are tubular, and have a distinct but minute orifice at their extremity; their interior communicates with a compartment between the stomach and the exterior muscular wall. This compartment is not single, but divided by delicate vertical laminæ into numerous sections or chambers, which, however, communicate freely together. This divided cavity is the aërating receptacle, and is filled with sea-water, taken in through the tubular tentacles, and expelled when the animal contracts through the same tubes. We have seen Actiniæ in water exhausted of air, and in which they have been kept too long, distend the aërating chamber to such an extent as to force the stomach partially through the oral aperture. In these respiratory chambers are the eggs or gemmules arranged in clusters on delicate membranes. It appears that these gemmules either pass through minute ducts into the stomach, and so escape by the mouth, or becoming attached are transmitted through the tentacles; but this point is not very definitely settled. According to the Abbé Diquemare the expansion of the Actiniæ is a more certain indication of fine weather than the rise of the barometer; but the animals can only be watched in summer, for, as he affirms, those that we see on the rocks change their abode on the approach of winter; some abandon themselves to the mercy of the waves, others creep along the bottom, turning themselves inside out, and making use of their tentacles as feet, till they find a suitable spot upon which to fix, in deep water, where the temperature is equable and mild. Many have noticed the tenacity with which the Actiniæ adhere to the rock, from which it is difficult to remove them uninjured: we have succeeded in obtaining numbers by cautiously insinuating a thin broad-bladed knife or spatula between their base and the surface of attachment, without inflicting the least injury.

Fig. 3847 shows a vertical section of Actinia: *a a*, the external tunic; *b*, the base; *c*, the rows of tentacles; *d*, the mouth; *e*, the stomach; *f*, longitudinal muscles uniting at the point *g*; *h h*, the egg-membranes with fine ducts opening into the stomach. Fig. 3848: *a*, the egg-membranes, greatly magnified; *b*, the duct; *c*, the eggs; *d*, the first appearance of the young; *e*, the same, more advanced; *f*, the same, still farther advanced.

Fig. 3849, the distribution of nerves at the base of Actinia: *a*, the nervous ganglions; *b*, the nerves; *c*, nerves of communication between the ganglions; *d*, muscular fibres. Fig. 3850, longitudinal muscles running up to the tentacles.

Having so far explained the general characters of this section Zoantharia, so far as they are presented by Actinia, we may now proceed to illustrate the different groups it comprises, excluding the Madreporidæ, which M. de Blainville includes in it, and of which we have already treated.

Fig. 3851 represents the small leathery Sea-Anemone, Actinia coriacea. This species dwells on low flat sandy shores, burying itself with great promptitude when molested.

Fig. 3852 represents the large leathery Sea-Anemone, Actinia senilis. This species is three inches broad, with a leathery unequal envelope of an orange colour; the tentacles are tinged with a rose colour. Like the preceding, it takes up its abode on the sand, and buries itself when alarmed.

Fig. 3853 is the purple Sea-Anemone, Actinia equina. The rocks and reefs along our Southern coast may be seen studded with this beautiful species, as if with flowers of the most lovely tints. The skin is soft and usually of a purple or olive green, and the tentacles are of the finest violet, mingled often with pink, yellow, and green; indeed the colours vary so much in different individuals, all alike beautiful, that it is impossible to describe them rigidly. Where the rocks along the coast contain basins or little pools of clear water, during the ebb of the tide these creatures may be contemplated on a fine day to great advantage, and few spectacles are calculated to afford more pleasure to a lover of nature. "Many a time and oft" have we watched them by the hour, and seen them engulf the prey which we have quietly placed within the grasp of their rainbow-tinted arms. They appeared to us to revel in the warmth of the sun, but to avoid its glare, affecting most the spots where the rays fell subdued; we never saw them change their place voluntarily.

Fig. 3854, the white Sea-Anemone, Actinia plumosa. In this species, which is white, the margin of the oral disc is expanded into lobes furnished with numerous tentacles. It measures upwards of four inches in breadth.

Fig. 3855 shows the upper surface and base of the Actinia (Discosoma) helianthes, in which the tentacles are extremely short.

There is a species of Actinia (A. Jordaica) found in the Mediterranean with deep crimson tentacles, which is esteemed by the Italians a great delicacy for the table; in tropical countries many species are used as food.

In the 'Ann. des Sciences Naturelles,' 1842, M. de Quatrefages describes some remarkable vermiform Actiniadæ under the generic title of Edwardsia. These animals are invested with a sort of membranous tube or sheath, which they coat over with particles of sand and gravel, compacted by means of a glutinous secretion. Three species were discovered by M. Quatrefages on the west coast of France, and a fourth was found by Professor E. Forbes in the Grecian Archipelago. This species, Edwardsia vestita, Fig. 3856, can move up and down freely in its membranous tube, and an individual kept for some time in sea-water, when the tube was injured came out of it altogether and moved about, twisting its body like an annelide. On being supplied with sand and gravel it proceeded to construct another covering, rolling itself up in the sand, and secreting glutinous matter for the membranous lining. It was very voracious, and attacked whatever animal came within the reach of its tentacles.

This species lives buried in the sand, in places a few inches below sea-level.

Another remarkable genus of the Actiniadæ is termed Iluanthus (Forbes, 'Ann. of Nat. Hist.' 1840): one species only is known, viz. Iluanthus Scoticus, Fig. 3857. The body is free and tapers posteriorly to a point, which is most probably buried in the soft mud among which it lives. The mouth is surrounded by numerous long filiform tentacles. This singular species was found in four fathoms of water in Loch Ryan.

A singular form of the Actiniadæ is that constituting the genus Capnea, Forbes; of which only one species appears to be known, viz. Capnea sanguinea, Fig. 3858, a native of the Irish Sea. The disc is round, with several circles of exceedingly short tubular and retractile tentacles; the lower part of the body is covered with a peculiar epidermic membrane, with its upper margin turreted.

We now turn to the family Zoanthidæ, which we may describe as Actiniæ springing from a common fleshy base or spreading root.

Fig. 3859 represents—A, Zoanthus Solanderi, from the West Indies; B, Corticifera glareola, from Guadaloupe; and C. Mamellifera auriculata, from the West Indies.

Another family, containing only one genus, is termed Lucernariadæ. The genus Lucernaria comprises several species of beautiful campanulate animals fixed to sea-weeds by a narrow disc or stalk, from which they expand into a broad octagonal surface with a tuft of tentacles at each angle, and in the centre a quadrangular mouth, round which are diverging festoons of egg-sacs. Intermediate between the tufts of tentacles are little coloured lobes, which some naturalists have regarded as eyes. All the species recorded are natives of the British and Norwegian seas. They measure about an inch in length and are usually of a pink colour; they swim with great rapidity, alternately dilating and contracting their bodies, but are usually to be seen adhering to fronds of sea-weed; they feed on small crustacea, which they seize while passing near, and which, if they really possess organs of vision, they perceive when approaching. Fig. 3860 represents the Lucernaria auricula. It does not appear quite certain that these animals belong to the same section as Actinia; they appear indeed to approach the Medusæ, and may perhaps be an intermediate link.

CLASS POLYGASTRICA.

There are two very distinct classes of animalcules, the Rotifera and Polygastrica, which the older naturalists confounded under the general term Infusoria, because it was principally in vegetable infusions that these atoms of creation were observed. But since the improvements of the microscope, diligent research has led to a better acquaintance with the structure of these beings, and enabled the naturalist to ascertain their distinguishing characters. The Polygastrica, or many-stomached animalcules, abound in the sea and in fresh waters; every cubic inch of which often teems with myriads. Some species however are far more common than others, and the water of every ditch, and every drop of vegetable infusion exposed for a few days to the sun and air, swarm with them. These animalcules appear to be divisable into two groups: one distinguished by the soft or shell-less condition of the body; the other by the body being more or less protected by an extremely fine and transparent shell, varying greatly in form in various species. The shelled Polygastrica are and have been among the agents by which the condition of the surface of our globe undergoes change. Rocks and extensive strata are replete with their exuviæ; as the countless myriads die through a long succession of ages, the accumulation of their hard investments mixed with calcareous or silicious matter becomes consolidated into clay, flint, chalk, &c. The Turkish stone used for making hones is a mass of the fossil relics of microscopic animalcules. In Sweden on the shores of a lake near Urnea is a vast quantity of an extremely fine pulverulent matter, resembling flour. It is called mountain meal by the natives, and is used as food, being mixed with flour. This mountain meal, which is apparently somewhat nutritive, consists of nothing else than the shelly coverings of certain polygastric animalcules, which as the animals perish accumulate from age to age at the bottom of the water and form a deep stratum, and this, as the water dries or retires from parts formerly covered, assumes the mealy appearance whence it has its name.

Some of the Polygastrica present wonderful changes of form, and seem as if they had no definite or settled configuration. Their actions lead to the inference that they are endowed with instinct. They know how to pursue their food, what to take and what to reject, and how to avoid danger. They swim about with great activity, and though thousands tenant a single drop of water, they steer clear of each other in their mazy dance, or pursue each other, the larger endeavouring to make the smaller their prey. The minutest of these animalcules which the finest microscopes have brought within our vision, are termed monads; they appear in the form of mere points or globules. Some idea of their minuteness may be formed when we state that five hundred millions move about freely and disport in a single drop of water. With respect to their organs of locomotion, some make for themselves at will arms or paddles by shooting forth portions of their body; others are furnished with vibratile cilia, or jointed bristle-like appendages; but in some no especial organs of locomotion can be discerned. According to Ehrenberg and others, the digestive

apparatus consists of a mouth leading into a number of internal sacculi, or stomachs, variously arranged in different species; sometimes, as Monas atomos, Fig. 3861, suspended by tubes in a cluster; sometimes, Leucophrys patula, appended to a winding intestinal tube. Fig. 3862 represents Leucophrys patula; and Fig. 3863 the alimentary canal with the appended sacculi. These sacculi, or presumed stomachs, are more clearly to be seen when the animals have swallowed water in which indigo or other vegetable colouring matter is suspended without being chemically dissolved. It must be observed that some zoologists differ from Ehrenberg as to the nature of these presumed stomachs. Professor Jones states that his own observations, made with a very powerful microscope, did not enable him to detect the arrangement of any tube or appended sacculi; nor was he able to perceive, when one of the carnivorous animalcules had swallowed another, that the prey was conveyed into one of these so-called stomachs, but only into what seemed a cavity excavated in the general parenchyma of the body. He states that these pretended sacculi have no appearance of being attached to any tubes by means of peduncles, and that so far from appearing to be connected with a central canal, as represented by Ehrenberg, they are in continual circulation, moving up one side of the body and down the other, and even changing their relative positions like the coloured granules visible in the gelatinous substance of the Hydra. In no instance, moreover, has he been able to detect a central tube, much less the branches leading from it to the sacs; and he adds that the circumstances attending the prehension of food would in themselves lead us to imagine a structure different from that described by Ehrenberg. He adduces by way of confirming his views the changes of form which these animalcules undergo when devouring prey nearly equal to themselves in bulk, and therefore incapable of entering one of these sacs. The mouth dilates to engulf the victim, and when this is swallowed the whole body becomes greatly distended. It is very remarkable that in the Hydra the granules referred to, which certainly are not stomachs, become tinged with the juices of the prey on which the creature feeds; these juices, by some means unknown at present, are absorbed by the granules, which, thus charged with nutriment, circulate through the gelatinous substance of the body.

The reproduction of the Polygastrica is by buds, by spontaneous division, and by eggs; and some species exhibit each of these modes of continuing the race. Fig. 3864 represents Bursaria truncatella, a large animalcule found in stagnant water, and visible by the naked eye. It is shown magnified and of the natural size.

CLASS ACALEPHÆ.

The Acalephæ, or Sea-nettles (ακαληφη, a nettle), constitute a most extraordinary class of living beings. They are natives exclusively of the ocean, which teems with them, from the intertropics to the polar circle. Among the strange and beautiful of the creatures which tenant the thronged and populous waters of the sea, they exhibit sometimes the most fantastic, sometimes the most elegant figures, adorned with colours of surpassing richness; nor is their variation in size less diverse than that of their forms. Some are so minute as to require the aid of a microscope in their examination; others form large masses, which as they float on the waves cannot but attract attention. Many shine with phosphorescent brilliance; as the vessel ploughs the briny water, or the oars of the boat throw up the spray, when darkness covers the face of the deep, they glitter like a shower of stars, and falling again are lost in a sea of effulgence. Some appear in the depths like balls of glowing metal; some move with an undulating course, appearing as they pass like a riband of flame; others like diamonds gem the rocks, or the fronds of seaweed; some float in shoals, displaying the lovely tints of the rainbow; while others, like orbs of silver, glitter as they float on the rolling current.

Most are endowed with the property of stinging the hand which touches them; hence their title Acalephæ, or Sea-nettles (first applied to some of the species by Aristotle), and the French name of "Orties de Mer." The stinging or smarting sensation which they cause, and which is often very painful and accompanied with inflammation, is owing to a peculiar acrid secretion which exudes from their bodies or tentacles.

They appear to be of a homogeneous and gelatinous consistence, and in reality are composed of filmy tissues, disposed in a cellular manner, and enclosing an abundance of sea-water, which when they are left dead on the beach soon dries up, leaving a little scum or filmy web behind. Yet they move at will, seize, devour, and digest their prey, many being even formidable to fishes. Often has it surprised us to find a large Medusa thrown upon the shore, reduced in a few hours, by the evaporation of the water it contained, to a trifling filmy shred of only a few grains weight.

The Acalephæ are divided into five distinct sections or orders, of which four derive their names from their organs of locomotion; but the fifth from the peculiar divided structure of the body, which consists of two parts joined together by a very slender attachment. The orders are: 1, Pulmonigrada (pulmo, a lung, and gradior, to advance); 2, Ciliograda; 3, Physograda (φυσαω, to inflate); 4, Cirrhigrada; 5, Diphyida (Δις, and φυὴ, natura). The Pulmonigrada (Pulmograda, De Blainville) derive their name from the circumstance of their alternate contractile and expansive movements, at regular intervals, like those of the lungs in the action of breathing, by which movements the animals propel themselves along on the surface of the water. We think, however, the term very objectionable, for it conveys the idea of moving by means of lungs; and might be advantageously changed for the term Discograda, as it is by the flapping of the disc that these creatures swim about.

The Pulmonigrade Acalephæ, or Jelly-fish, as Medusa and others, resemble in form a mushroom or expanded umbrella, or the section of a globe, more or less concave below. On the under surface is seated the oral orifice, but in some there are certain pendent processes, which are destined for the absorption of nutriment, and in others there is a proboscidiform appendage.

The circumference of the disc is often furnished with tentacles, which appear to be used in the capture of food; indeed, fishes of some size have been found enfolded by them, and quite dead, killed probably by the stinging quality with which they are endowed.

But though the species with mouths may swallow fish, in the Rhizostoma, which has no mouth, such prey cannot be swallowed. In this form there is a thick peduncle, divided into eight foliated laminæ, and terminating in as many dilated appendages. The appendages and foliated laminæ are traversed by canals with absorbing orifices opening externally; and these canals ascending the peduncle, ultimately merge into a single tube leading directly into the stomach or digestive cavity placed in the centre of the disc. It is then by the absorption of fluid containing myriads of animalcules through the minute apertures of the foliated peduncle, that nutrition is effected. From the stomach radiate canals anastomizing and dividing, and ultimately merging into a circular tube running round near the margin of the disc; whence again arises a border plexus of fine tubes like delicate network, the respiratory portion of this arterio-nutritive system. A very large species, the Rhizostoma Cuvieri, is abundant in our seas, and after a storm hundreds are often thrown on the shore.

In other forms the mouth itself leads into the digestive cavity, which is generally divided into four compartments by an extremely delicate membrane with branching tubes in various directions, and marginal egestive orifices. There is also round the margin a series of granular bodies, perhaps of a glandular nature, which appear to communicate by means of minute tubes with the nutritive canals. Their use is unknown. With respect to the organs of the senses, Ehrenberg and Dr. Grant consider that in the Cyanea aurita organs of visions exist in the form of eight small red points in depressions around the margin of the disc, and Dr. Grant considers that in some of these beings he has been able to detect a nervous system. The subject is still however in obscurity. The Medusæ are certainly sensitive; they even appreciate the influence of light, and when floating on the calm sea, direct their own course, and avoid danger, insomuch that it requires some dexterity to catch them by means of a net or boat-hook, for as they near the boat they gradually sink, as if alarmed by the motion of the oars; and indeed when we attempt to seize them in the water, they avoid our grasp with far more address than might be imagined from their appearance.

The egg-sacs are radiated, and open into the stomach, and besides these there is, strange to say, in certain species, as in Cyanea aurita, a marsupial apparatus in the form of small flask-shaped processes developed on each side of the oral tentacles; from the egg-sacs the eggs, in some manner not fully understood, are transmitted to the pouches; here they develop, and in due time the young Medusæ make their exit in the form of ciliated animalcules, afterwards they assume the form of an eight-armed polype, and ultimately, in February or March, undergo their final metamorphosis. The marsupial pouches are deciduous, and disappear soon after the escape of the young.

It is satisfactorily proved that some of the Medusæ, and perhaps all, are diœcious, the male and female being distinct. In many seas the water is crowded with myriads of small luminous species; for example, in the Red Sea, according to Mr. Salt, they teem in such profusion as to bear a proportion of one-third or even one-half to a given volume of the water. We must now turn to our Pictorial specimens. Fig. 3865 represents Eudora undulosa, in which, according to Péron and Lesueur, the body is greatly depressed, and without cirrhi or peduncles; and exhibits internally only ramified canals, with four large trunks forming a cross: *a*, the upper surface; *b*, the same in profile; *c*, the under surface. With respect to several points of structure in the genus Eudora further observations are needed.

Fig. 3866 represents Charybdæa periphylla. The body in the genus Charybdæa is hemispherical or subconical, and furnished at its circumference with foliaceous subtentacular lobes. The stomach is a very extensive excavation with a large aperture. Another genus belonging to the South Seas is termed Æquorea. In this the circumference of the disc is furnished with a circle of long filamentous tentacular cirrhi. The under surface is much elongated, and in one species, Æquorea cyanea, numerous linear tubes or sacculi radiate from the digestive cavity towards the circumference. Fig. 3867 shows Æquorea cyanea: *a*, the animal complete; *b*, a portion cut away. It is a beautiful species, of a fine azure colour.

On the coasts of Europe we often see a species of Thaumantias, viz. Th. cymbaloïdea, Fig. 3868, in which the marginal tentacles are bulbous at the root; the digestive cavity is prolonged into a free pedunculiform appendage divided into canals, and terminated by a simple mouth. It is of small size.

In the genus Tima the body is hemispherical with short marginal cirrhi, and produced beneath into a thick conic peduncle, terminated by a plicated enlargement; the oral orifice is at the apex of this conical prolongation, which contains the digestive cavity; and four tubes run from it to join the marginal canal.

Fig. 3869 shows the Tima flavilabris, found in the seas of the Azores.

In the genus Dianæa the body is hemispherical, furnished at its circumference with a small number of tentaculiform cirrhi of considerable length. The under surface is excavated, and from the centre is continued a proboscidiform appendage, with four prehensile organs at its extremity.

Fig. 3870 represents a species of Dianæa (Quoy and Gaimard). It is found in the Southern Ocean.

The genus Favonia has no marginal cirrhi or tentacles, and is rather deeply excavated beneath, whence is prolonged a slender median proboscis surrounded at its root by six or eight fringed appendages, furnished with radiciform suckers.

Fig. 3871 shows the Favonia octonema, from the Southern Ocean.

Allied to the preceding genus is that termed Lymnorea; in this genus, however, the hemispherical disc is furnished at its circumference with very fine, short, and numerous tentacular cirrhi. The under surface is excavated, and from the centre depends a long proboscidiform appendage, having at its base eight bifid and finely divided filaments.

Fig. 3872 represents Lymnorea triedra, from the South Seas.

We now come to the species with foliaceous peduncles, of which one is represented by the genus Pelagia, in which the body is hemispherical and bloated, and furnished on its circumference with a few long tentacular cirrhi. There are said to be eight inferior oral apertures at the end of a peduncle, from which depend four beautiful foliaceous arms.

Fig. 3873 represents the Pelagia Labiche (Cyanea Labiche, Quoy and Gaim.).

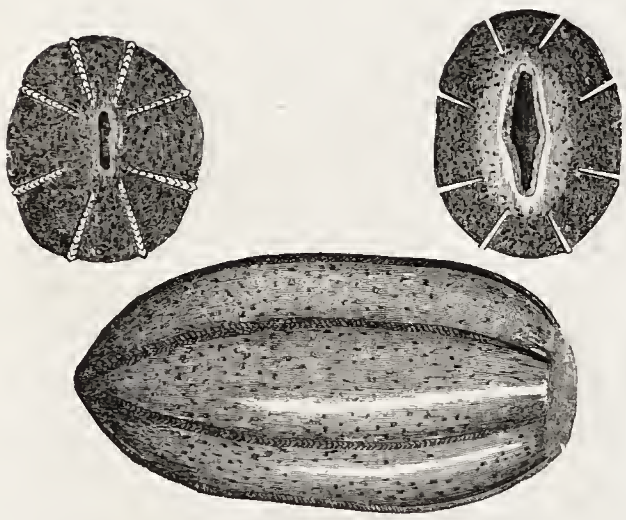
Another genus, termed Chrysaora, has the body, which is hemispherical, margined by at least twenty-four tentacular cirrhi; internally it is excavated into a considerable cavity with sacciform appendages, communicating externally by a single oral orifice, pierced in the centre of a median peduncle, from which depend four long feather-like arms. Fig. 3874 represents Chrysaora lutea: *a*, a fourth of the disc, seen from below; *b*, the disc without its appendages.

We now turn to a genus of which various species tenant our own shores, viz., Rhizostoma, in which the body is hemispherical with a somewhat lobated or festooned margin, and largely excavated below. From the centre depends a complex foliaceous appendage, to which we have already made allusion. Fig. 3875 represents the Rhizostoma Cuvieri, one of the common jelly-fishes of the European seas. It attains to a large size, and weighs several pounds, although, as we have said, when the water contained in the cellular film, and which in some mysterious way is connected with its vitality and the performance of its functions, is drained away, the mass of four, five, or even six pounds scarcely amounts to as many grains.

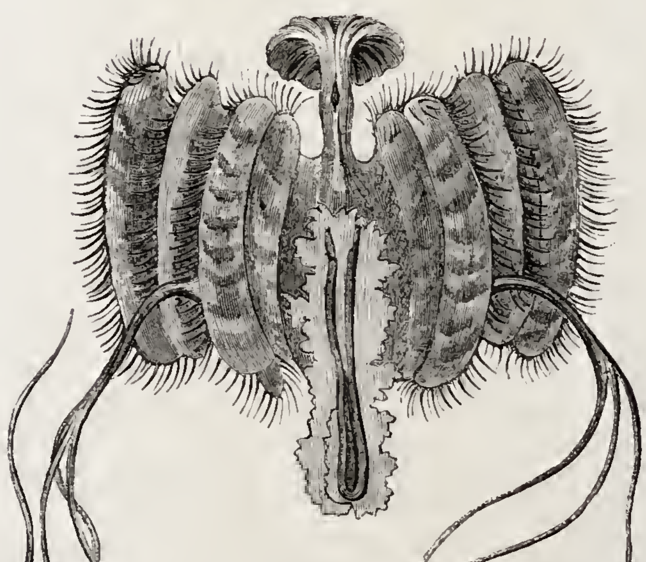
3874.—Chrysaora lutea.

3881.—Portions of Apolemia Urania.

3879.—Physalia pelagica.



3876.—Beroe ovata.



3877.—Callianira triploptera.

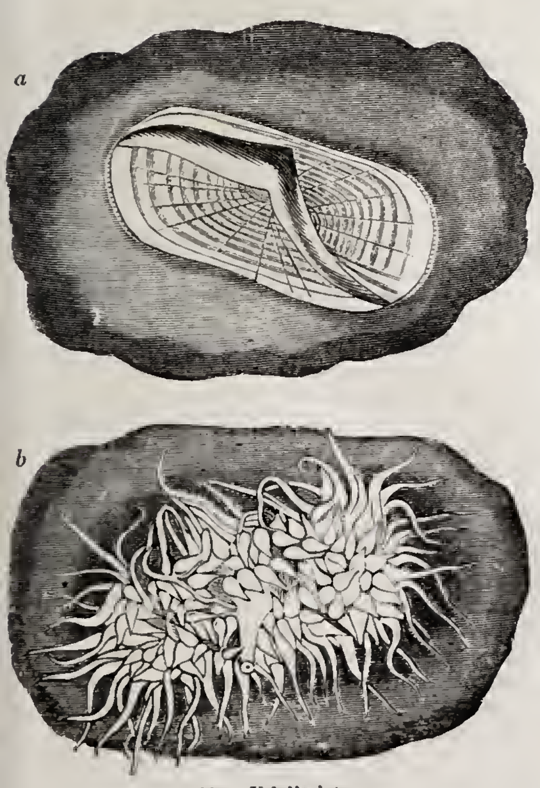
3878.—Cestum Veneris.

3880.—Rhizophysa filiformis and Physsophora Muzonema.

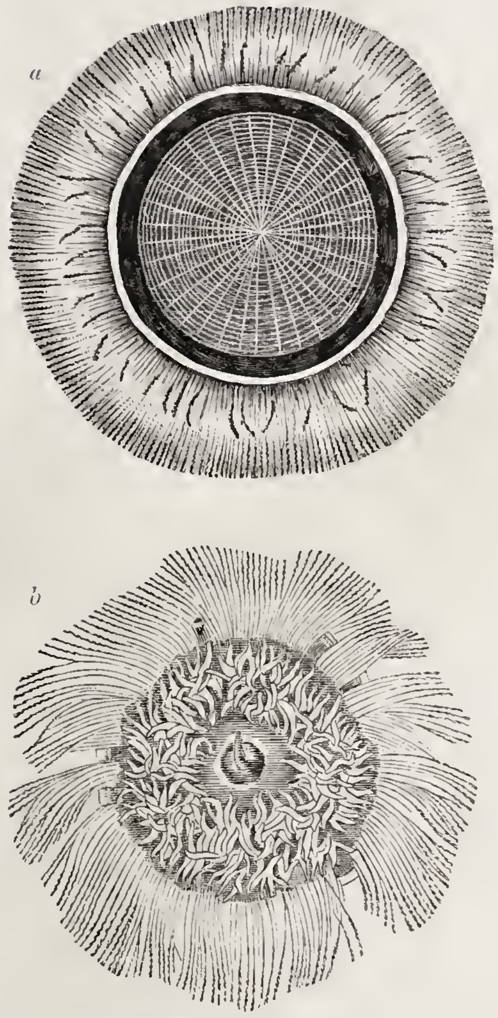
3882.—Protomedea lutea.

3883.—Rhodophysa helianthus.

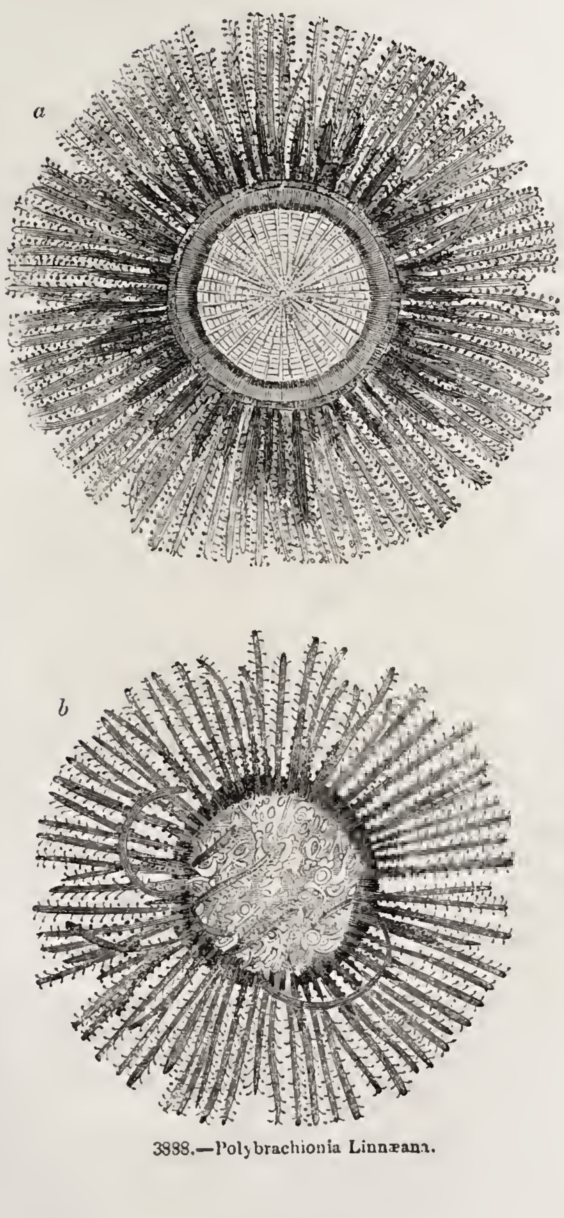
3887.—Porpita glandifera.



3884.—Velella lata.

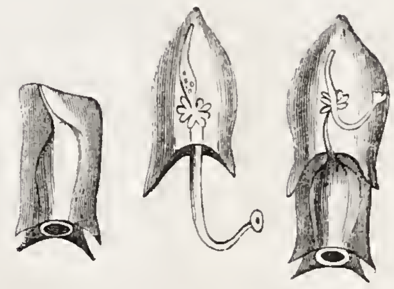


3886.—Porpita gigantea.



3888.—Polybrachionia Linnæana.

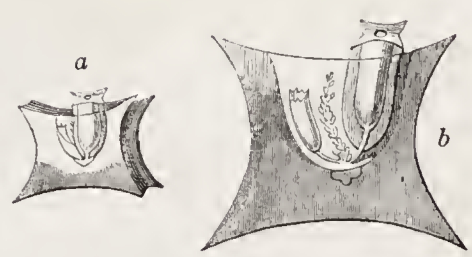
3891.—Navicula sagittata.



3890.—Cucullus Doreyanus.

3889.—Cucubalus cordiformis.

3885.—Rataria mitrata.



3892.—Cuboides vitreus.

3893.—Enneagone hyalina.

The Ciliograda, or Ciliograde Acalephæ, next demand our notice. These are transparent gelatinous animals, spread throughout all seas, and moving by the agitation of myriads of minute cilia with which they are provided. It is on this circumstance chiefly that the groups agree, for in external form they greatly differ from each other. In Beroe we have a globular or oblong body with eight longitudinal ridges, upon which are attached a set of little cilia, which work with great rapidity, and produce currents in the circumambient fluid. Fig. 3876 represents the Beroe ovata. It is found in the seas of the West Indies. The form of the body is oval; it is hollow internally and open at the larger end; its structure is firm, gelatinous, and transparent, and it contracts and expands with great facility. When swimming it is always open and expanded, and the cilia work with the greatest celerity in either direction. "It is impossible," says Browne (Jamaica), "to express the liveliness of the motion of these delicate organs, or the beautiful variety of colours that rise from them while they play to and fro in the rays of the sun; nor is it more easy to express the speed and regularity with which the motions succeed each other, from one end of the rays to the other."

In the genus Cydippe, of which Cydippe pileus is an example, the cilia are composite, and so arranged side by side as to form eight belts of paddle-wheels; each paddle-wheel consists of a number of cilia placed side by side like the barbs on a feather. The separate cilia, according to Dr. Grant, are tubular, and under the arches which support them are tubes containing a fluid for filling them. But besides these cilia the Cydippe pileus is furnished with two long slender filamentous tentacula, beset with highly sensitive and delicate fibrils; these tentacles and their fibrils are thrown into spiral coils on the slightest touch, or withdrawn into the body.

We may here notice a genus termed Callianira, established by Péron and Lesueur, and which is probably allied to Beroe. The body is regular, gelatinous, hyaline, cylindrical, elongated, tubular, obtuse at the two extremities, and provided with two pair of wing-shaped appendages which develop themselves in large foliations, and are fringed with a double row of vibratory cilia on their edges, and furnished with a pair of tentaculiform appendages, and not ciliated. At one extremity there is a large transverse opening, and probably another, but smaller, at the opposite extremity. Fig. 3877 represents Callianira triploptera: locality doubtful.

In another very remarkable animal, the Cestum Veneris, or Girdle of Venus, we are presented with a very different form, viz., that of a long riband measuring five or six feet in length; the upper and lower margin are furnished with a double row of cilia, of varying and most brilliant tints, and luminous during the night with phosphorescent lustre. This resplendent creature has been observed in the Mediterranean, but appears to be extremely rare. The alimentary canal crosses the breadth of the middle of the riband, the mouth being situated below; from the digestive apparatus nutritive tubes are given off, and follow each row of cilia, while another tube runs along the median portion of the riband from end to end. Fig. 3878 represents the Cestum Veneris, of which we know nothing, except from Lesueur's account and some details communicated by M. Martens of the Russian expedition round the world to M. de Blainville.

The Physograda, or Physograde Acalephæ, constitute a singular group of animals, which float in the water either by means of a set of vesicles distended with air, or the body itself, as in the instance of the Portuguese Man-of-war, assumes a vesicular form, capable, it has been said, of being inflated and emptied at will, the animal sinking when the air is expelled; an assertion, however, which is erroneous. What the nature of the air in these vesicles is has not been determined; it appears to be a secretion furnished by the animal itself, and not taken in from the atmosphere.

Few marine animals of the present class are more interesting to the voyager as he crosses the tropical seas than the Portuguese Man-of-war (Physalia pelagica). Tinted with blue, green, and crimson, shoals of these creatures float past the vessel glittering in the sunbeams as the current carries them onwards. The Physalia consists of an oblong air-vessel surmounted by a fringed crest or sail. From the under portion of the air-vessel hangs down a group of tentacula of three kinds: first, an anterior cluster of short tubular filaments tufted in their pedicles; secondly, a number of long filaments varying in extent; and thirdly, a set of still longer tentacles, having a thick and firm base, and muscular fibres continued along their course: "The longest of these appendages," according to Mr. G. Bennett, "are used by the Physalia for the capture of its prey, and are capable of being coiled up within half an inch of the air-bladder, and then darted out with astonishing rapidity to the distance of twelve or eighteen feet; twining round and paralyzing by means of an acrid secretion any small fish within that distance. The food thus seized by the tentacula is rapidly conveyed to the short appendages or tubes, which are furnished with mouths for its reception. These tubes appear to constitute the stomach of the animal, for upon a careful dissection nothing like a common receptacle for food could be observed, nor could Mr. Bennett detect any communications between them and the air-bladder, to the inferior portion of which they are attached by means of a dense muscular band. After an examination of an immense number of specimens, Mr. Bennett was unable to discover the orifice usually stated to exist at the pointed end of the bladder, nor could he ever succeed in expelling any portion of the contained air without a puncture being previously made. This organ consists of two coats, the outer of which is dense and muscular, readily separating from the inner, which resembles cellular membrane.

The partial expulsion of air from the bladder did not at all affect the buoyancy, or appear in any way to incommode the Physalia; and even when it had completely collapsed the animal still floated on the surface. Upon removing the bladder entirely, the mass of tentacula sank to the bottom of the vessel, and though their vitality remained, all power of action was entirely destroyed." ('Proceeds. Zool. Soc.' 1837, p 43.)

The tentacles are very irritable, and the secretion which exudes from this produces on the hand they touch extreme pain and inflammation. Mr. G. Bennett thus describes what he suffered on being stung on two of his fingers:—"The sensation was similar at first to that produced by a nettle, but before a few minutes had elapsed a violent aching pain succeeded, affecting more severely the joints of the fingers, the stinging sensation at the same time continuing in the part first touched by the acrid fluid. On cold water being applied with the intention of removing or lessening the pain, it was found rather to increase than diminish the effects. The irritation resulting from the poisonous fluid extended upwards, increasing in severity, apparently acting along the course of the nerves, and in the space of a quarter of an hour the effect in the fore-arm was very violent, and at the elbow-joint still more so. It may be worthy of remark that when the joints became affected the pain always increased. It became at last almost unbearable, and was much heightened on the affected arm being moved. The pulse of that arm was also much accelerated, and an unnatural heat was felt over its whole surface. The pain extended to the shoulder-joint, and on the pectoral muscle becoming attacked by the same painful sensation, an oppression of breathing was occasioned, and proved very distressing. The continuance of the pain was very severe for nearly half an hour, after which it gradually abated; but the after effects were felt during the remainder of the day in a slight degree of numbness and increased temperature of the arm. About two hours after I had been stung I perceived that a vesicle (blister) had risen on the spot."

The tentacles of the Physalia are of a beautiful purple with a mixture of crimson, and have a peculiar odour. The crest or sail is irritable as well as the tentacles, and expands or contracts under varying circumstances. It is of a blue colour with streaks of sea-green blended with rich crimson. After death the exquisite colours of this animal, which render it so attractive to the eye, gradually fade away.

During rough weather numbers of Physaliæ are often thrown on the beach, where they are found with the air-bladder still inflated, a sufficient proof the animal has no power of getting rid of the air and then sinking for safety. Though the Physalia is principally to be seen in the tropical seas, it occasionally visits the shores of our island in considerable numbers, which, in loose companies, are carried along, passively yielding to the current or the breeze.

Fig. 3879 represents the Physalia pelagica (Physalus pelagicus, Lamarck; Physalia Arethusa, Browne). The crest is retracted, and only just appears.

Of species in which the swimming organs are complex and vesicular, we may turn to the following strange beings, of which mere description will convey a very inadequate idea, and indeed respecting which much remains to be known.

Fig. 3880 represents—A, Rhizophysa filiformis, a slender transparent filiform species, with an air bladder at one extremity: B, Physsophora Muzonema, in which there are two series of vesicular bodies, to which are appended numerous diverse cirrhiform productions or tentacula.

Fig. 3881 represents a portion of Apolemia Urania: *a*, a part still more highly magnified; *b*, a single sucker. In this genus the body is greatly elongated, cylindrical, and vermiform, provided anteriorly with many natatory organs in two rows; and behind with solid squamous organs, between which come forth tentaculiform cirrhi furnished with vermiform suckers.

Fig. 3882 represents Protomedea lutea: the body is long, and furnished above with an imbricated assemblage of gelatinous bodies in two alternate rows; from the base of this imbricated float hang filamentous tentacles with cirrhi.

Fig. 3883 represents Rhodophysa helianthus. In this form the body is short and cylindrical, swollen above into an air-bladder, and provided below with a variable number of petal-like gelatinous bodies and tentaculiform cirrhi.

The Cirrhigrada, or Cirrhigrade Acalephæ. may now be noticed. In the animals of this group we find an internal delicate calcareous or cartilaginous support, forming a sort of skeleton or axis. The Cirrhigrada move in the water by means of cirrhi or tentaculiform appendages numerously disposed on the under surface; and some, as the Velella, have an elevated membrane or sail on the upper surface.

In Velella the body is membranous, oval, very much depressed, convex above, showing a transparent, oval, cartilaginous, dorsal shield, marked with concentric striæ, and surmounted by a vertical and oblique crest of a delicate semicartilaginous structure, which acts as a sail, and aids the cirrhi. Below the body is concave, with a central proboscidiform mouth, surrounded by numerous tentacular cirrhi, those which are most external being the longest. Several species appear to exist in the warmer seas. Fig. 3884 represents the Velella lata: *a*, the upper surface, showing the dorsal shield and crest; *b*, the under surface, showing the mouth and tentacles. The colour of these creatures is a fine blue, and as shoals float along, often of great extent and in compact order, they present an interesting spectacle. They are found in the seas of Europe, Asia, Australasia, and America. Velellæ are occasionally washed upon our shores during storms.

Closely allied to Velella is the genus Rataria, in which the body is oval or circular, and sustained by a subcartilaginous, compressed, elevated piece, with a muscular, moveable, longitudinal crest above; the under surface is concave, with a central proboscidiform stomach surrounded by a single row of marginal tentacula. The species known are very small, and transparent. Fig. 3885 represents Rataria mitrata, greatly magnified. May not some of the species be the young of Velella?

Another genus is Porpita. The body of the animals of this genus is flat and circular, and the outer membranous tissue invests a cartilaginous circular plate, concentrically striated, and also in a radiating direction. This plate is extremely light and porous, and acts as a sort of float. The body is somewhat concave below, and furnished with a vast number of tentacula, of which the outermost are the longest, and furnished besides with small cilia, each terminated by a globule; the inner tentacles are simple; the mouth is central and proboscidiform, and conducts to a simple stomach imbedded in what appears to be a glandular mass. The creatures are of a most beautiful blue, and are common in the Mediterranean and the warmer seas.

Fig. 3886 represents Porpita gigantea: *a*, the upper surface; *b*, the under surface.

Fig. 3887 represents Porpita glandifera, in profile. From the genus Porpita have been separated some species, forming the genus Polybrachionia of Guilding. The tentacles are extremely numerous, and the dorsal disc vitreous. Fig. 3888 represents the Polybrachionia Linnæana, enlarged: *a*, the upper side; *b*, the lower side. This species is very beautiful, and may be seen in calm weather floating on the tranquil surface of the Caribbean sea, and ever and anon entwining its arms with great address and promptitude around its prey. The body is azure blue, the tentacles of a pallid tint. This animal is probably the Porpita cærulea of Eschscholtz.

The Diphyida (Diphydes or Diphydæ), to which we now invite attention, constitute a strange group of marine creatures, the nature of which is enveloped in much obscurity. In general the body consists of two distinct portions or individuals, one of which, viz. the posterior, is fitted into a cavity or hollow receptacle of the other, or anterior portion; but so slight is the union between them, that they fall asunder on the merest touch. These two parts are more or less dissimilar in form; and from the root of the nucleus of the receiving or anterior individual emerges a long cirrhiform appendage prolonged more or less backwards. The structure is subcartilaginous and transparent, and in both portions is ordinarily to be seen a cavity more or less funnel-shaped, opening externally by a wide and regular, though diversiform aperture. It is by the alternate contraction and dilatation of these cavities, the water at each contraction being smartly thrown out, that the animal is

propelled along. The anterior part contains moreover a proboscidiform œsophagus, with a mouth having a sucking-glass margin continued into a stomach surrounded with green hepatic granules (rudiments of the liver), and sometimes a second filled with air. Besides this, there is at the lower part a glandular mass, probably the egg-vessel, and which is in more or less immediate connexion with the cirrhiform prolongation.

"The Diphydes," as M. de Blainville remarks, "are very transparent animals, so that it is often very difficult to distinguish them in the sea, and even in a certain quantity of water taken from it. It is especially at extremely great distances from the shore that they are met with in the seas of warm climates, and often very numerous. They float and swim apparently in all directions, with the anterior or nuclean extremity foremost, getting rid of the water they take in by the contraction of the two subcartilaginous parts; their aperture consequently is always directed backwards. When the two natatory organs are equally provided with a special cavity, it is probable that the locomotion is more rapid: it can finally be executed by either the one or the other in proportion to their size. The posterior portion is attached to the nucleus with so little solidity that it often becomes detached from it accidentally; hence M. Botta believed that an entire Diphyes was only formed by one of those parts, he having but rarely found these animals complete. During locomotion the cirrhigerous production, or egg-tube, apparently floats extended backwards, lodging itself partly in a gutter into which the inferior edge of the posterior natatory organ is hollowed out; but it has not the same length, the animal being able to contract it powerfully, even to the extent of drawing it entirely inwards. From this it is evident that the organ is muscular; what, however, is remarkable is that throughout its length, and placed at tolerably regular intervals, are found organs which MM. Quoy and Gaimard regarded as suckers, and which possessed in fact the faculty of adhesion and bringing the animal to anchor, as M. Botta was satisfied. I dare not decide what this organ is; but I am strongly inclined to believe either that it is a prolongation of the body analogous to that in the Physsophoræ, or if not an egg-tube, is at least an assemblage of young individuals." M. Eschscholtz regarded it as a nutritive canal; either simple, or provided with one or with several suckers. M. de Blainville divides the Diphyida (or Diphydæ), first, into such as have only a single cavity in the anterior part; secondly, into those whose anterior part is furnished with two cavities; thirdly, into doubtful species, with only one part, as far as known. Of these three minor groups we shall give several examples, which will show what strange and unexpected forms are presented by animals of the lower orders of creation. They are represented so as to show the two parts in their natural union, as well as apart, and also in several aspects.

To the first group belong the following species:—

Fig. 3889, Cucubalus cordiformis, of a heart-shape: the animal swims vertically.

Fig. 3890, Cucullus Doreyanus (Quoy and Gaimard), from the seas of New Guinea. It is closely allied to the preceding form.

Fig. 3891, Navicula sagittata (De Blainville); Cymba sagittata (Quoy and Gaimard). This singular species is found in the Straits of Gibraltar. The term Cymba has been appropriated by Mr. Broderip to a genus of shells (Volutidæ), and must therefore be suppressed in this instance.

Fig. 3892, Cuboïdes vitreus, from the Straits of Gibraltar: *a*, the natural size; *b*, magnified.

Fig. 3893, Enneagone hyalina (Quoy and Gaimard): 1, 1 *a*, and 1 *b*, the animal under different aspects; 1 *c*, the visceral part; 1 *d*, the nucleus.

Fig. 3894, Amphiroa alata (Lesueur), from the seas of Bahama: 1, 1 *a*, the animal in two aspects; 1 *b*, its nucleus extracted.

The second group, containing species whose anterior part is furnished with two distinct cavities:—

Fig. 3895, Calpe pentagona, from the Straits of Gibraltar: 1, the animal in profile; 1 *a*, the under side; 1 *b*, the nucleus.

Fig. 3896, Abyla trigona, from the Straits of Gibraltar: 1, the anterior view; 1 *a*, the posterior; 1 *b*, the visceral portion.

Fig. 3897, Diphyes Bory (Quoy and Gaimard); Diphyes Campanulifera (Eschscholtz). This species is spread in all seas, and is the most common species. 1, the entire animal, profile; 1 *a*, the anterior part of the same; 1 *b*, the posterior part; 1 *c*, the entire animal, magnified; 1 *d*, posterior part of the same. For the account of an allied species, D. elongata, taken on the coast of Ireland, by G. C. Hyndman, Esq., see the 'Ann. and Mag. of Nat. Hist.,' May, 1841, p. 164, et seq.

The third group, containing doubtful species, or those with one part only, and respecting which our information is very limited:—

Fig. 3898, Pyramis tetragona. Of this nothing is known beyond what can be collected from a description and figure by M. Otto.

Fig. 3899, Praia dubia: this singular animal is rather soft, and of a subgelatinous structure, and very transparent; it is divided by a longitudinal furrow, and has a shallow cavity with a rounded aperture.

Fig. 3900, Tetragona hispidum, with details. M. de Blainville regards this as nothing more than the posterior part of a true Diphyes.

Fig. 3901, Sulculeolaria quadrivalvis, from the Mediterranean. M. de Blainville is strongly inclined to believe that this is not an entire animal, but a portion of Calpe.

Fig. 3902, Galeolaria australis. According to M. de Blainville, this animal approximates towards Beroë.

Fig. 3903, Rosacea Ceutensis: this species is suborbicular in form, very soft and transparent, with a single terminal aperture, whence proceeds a cirrhiform process.

Fig. 3904, Noctiluca miliaris. This little animal is provisionally placed among the Diphyida. It was first observed by M. Surreray, in the sea at Hâvre, and in the dock and basins it occurs in such numbers as to form not unfrequently a film on the surface of the water. It is about the size of a pin's head, with a moveable proboscis which it agitates in all directions, and by means of which it executes its deliberate aquatic evolutions. This proboscis is tubular, and appears to be composed of annular fibres; it is in fact an organ of nutrition as well as of locomotion. The Noctiluca is as transparent as crystal, and from its phosphorescence is extremely brilliant at night, gleaming like a sparkling diamond, and where myriads are crowded together giving effulgence to the water. Its splendour is the greatest in stormy but hot weather; in winter its phosphorescence is diminished, and lost when the wind is from the west.

Another form of this group is presented by Doliolum Mediterraneum. This animal, found in the Mediterranean, appears to consist of nothing more than a gelatinous hyaline cylindrical body resembling a barrel in shape, with a large opening at each extremity; and it is stated to swim by alternately absorbing and ejecting the water from the two apertures. It is not improbable that the Doliolum may be either the young of some species unascertained, or a portion of some other diphyidous animal, still retaining its vitality. The fact is that the history of the Diphyida is yet involved in great obscurity, and a series of observations are requisite before we can hope to have the difficulties cleared up in which their structure and economy are enveloped. The little known only tends to excite our astonishment.

CLASS STERELMINTHA

(PARENCHYMATOUS WORMS). Most of the Sterelmintha inhabit as parasites the bodies of other animals, and from the fluids of those bodies derive their nutriment. They are not however confined to one given locality; it is not only in the alimentary canal that they take up their residence, but in the substance of the brain, in the abdominal cavity, in vessels of the liver, in the cellular tissue, and in the substance of the muscles. They infest quadrupeds, birds, fishes and reptiles, nor is man himself excluded. In many cases their presence proves ultimately fatal, and is always connected with a diseased condition. The Sterelmintha differ in size and external form; some being microscopic, others attaining to the length of many yards. Their structure is simple, but that of some much more so than that of others.

The Sterelmintha, or Parenchymatous Entozoa of Cuvier, are divided into four groups or orders: 1, Cestoidea; 2, Tænoidea; 3, Trematoda; 4, Acanthocephala.

In the Cestoidea the structure is very simple. The only genus, Ligula, comprehends certain worms of a flat riband-like form, striated once longitudinally, and repeatedly in a transverse direction. These worms inhabit the abdominal cavity of birds, but more especially of fishes, and prove fatal. One species, the Ligula Cingulum, Rudolphi, found in the bream, attains to the length of five feet. There are strange tastes among men, but few would think of making this worm an article of diet; yet Cuvier says that in some parts of Italy it is regarded as an agreeable viand.

The Tænoidea present us with two distinct forms, represented one by Tænia, the Tapeworm, the other by Cisticercus, or the Hydatids.

The Tænia, of which certain species infest the human subject, consists of a series of flattened segments, commencing by a small square head, the articulations succeeding which are small, and gradually increase in size. The Tænia solium is generally met with in England; and the Tænia lata in Russia, Poland, Switzerland, and, we believe, America: a species, Tænia lamelligera, Owen, occurs in the Flamingo.

In Tænia solium the mouth is placed in the centre of a square head surrounded with minute hooks; and four suckers occupy each angle respectively. By means of these hooks and suckers, the animal is enabled to adhere to the lining membrane of the small intestines, and there imbibe chyle. Each segment, excluding those which immediately succeed, contains an arborescent apparatus in which the multitudinous eggs are produced, so that, excepting that of the nutritive apparatus, which is continued throughout, each segment may be almost regarded as a distinct being. Fig. 3906 represents portions of the Tænia: 1, two joints of T. solium, magnified, in one of which are seen the numerous eggs, which pass through the egg-duct *a*; 2, some of the eggs, magnified; 3, the head, seen in front, with the mouth in the centre surrounded by hooks, and by the four suckers *a a*, two of which are alternately protruded and retracted; 4, the mouth with its hooks; 5, two of the hooks, greatly magnified; 6, a sucker, greatly magnified.

As the eggs are in myriads, and yet seldom more than one Tænia infests an individual, the query arises, what become of the germs thus multitudinously produced? do they perish, or do they assume other forms till placed by accident in a nidus favourable to their due development?

The Hydatids, or Cysticerci, consist of a transparent sac or globular vesicle containing a fluid; this vesicle has one or many heads, according to the species. The ordinary Hydatid with one head (C. longicollis) is found often in enormous abundance in the liver and abdominal cavity of quadrupeds, especially of the Ruminant order. The many-headed Hydatid (Cœnurus cerebralis) is common in the brain of sheep, destroying the animal by pressure on that organ, as it increases in size. They multiply by internal gemmules, and are often found filled with smaller ones floating in the glairy fluid.

The Trematoda are represented by that singular little sole-like parasite called the Fluke (Distoma hepaticum), La Douve of the French, so common in the liver of sheep. An allied genus, Polystoma (Hexastoma, Cuvier), presents us with several species, two of which infest the human subject, one (P. venarum) inhabiting the veins.

To this section belong the Planariæ, not parasitic, found in fresh and salt water, where they creep on the leaves and stems of plants like small black flattened leeches: they feed on insects, worms, &c.

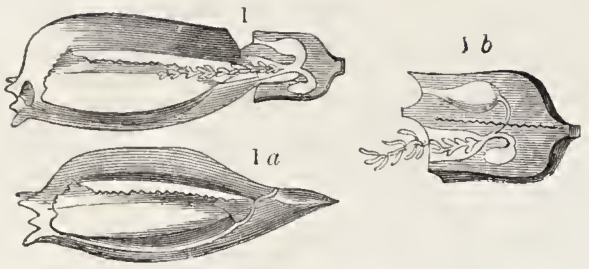
We must here also place an allied group of marine worms, constituting the genus Nemertes of Dr. Johnston; they are very minute, and live under stones in mud, between tide-marks. Both these and the Planariæ bear division with impunity. ('Mag. of Zool. and Botan.,' vol. i. p. 529.)

A minute parasite, the Diplozoon paradoxum, is found on the gills of the bream; it is about three lines long, and is somewhat cruciform in figure, or rather resembles two distinct leech-like animals, joined, as were the Siamese twins, by a median band of union. It is in fact a double animal, of which each side has the same parts, but the digestive apparatus is common to both. On each head are two suckers, and on each posterior extremity two oval plates of membrane, with four suckers each; and thus is its adhesion to the slippery gill-covers of the fish secured.

The Acanthocephala includes only one distinct genus, Echinorhynchus, of which the species termed Echinorhynchus gigas is often found in abundance in the alimentary canal of the hog. This Entozoon is diœcious, the male and female being distinct. The female exceeds the male, and attains to the length of fifteen inches. The figure of this parasite is elongated, tapering to the tail; the head consists of a retractile snout or proboscis, armed with four circlets of sharp recurved spines, which serve as holders; it can be withdrawn by means of retractor muscles, and protruded at will. At the extremity of this spine-armed proboscis is the mouth, a simple suctorial orifice leading to a double nutritive canal. The female produces eggs.

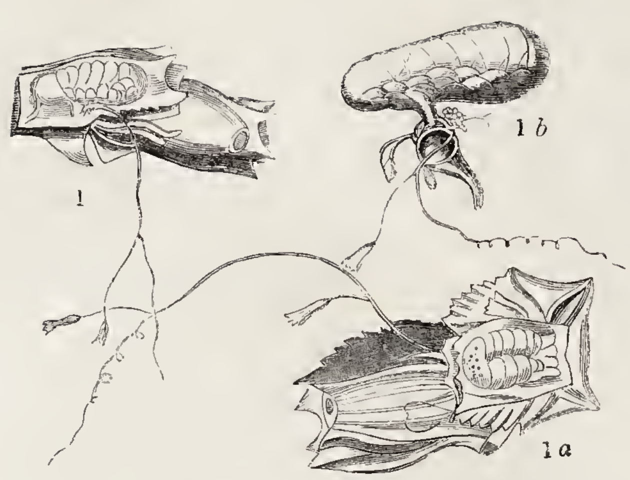
With respect to the manner in which the Sterelmintha, as the Tænia, and especially the Hydatids, the Distoma or Fluke, the Polystoma venarum, &c., obtain admission to the brain, the substance of the liver, the inside of the veins, and other localities in which they are found, much obscurity exists. Their spontaneous production is out of the question,—the idea is an absurdity: we can only suppose that their eggs or germs of great minuteness must exist in some form at present unsuspected, and in a dormant state, and be received into the alimentary canal, where some become developed, and there remain, while others are taken up by the lacteals, and carried ultimately into the circulating system, where again some develop themselves, while others are carried to various organs, as the brain and liver, in which they meet with a suitable nidus for their perfection; and where supplied with abundant nutriment, and fostered by the animal heat, they grow inordinately.

Various species are known to exist under the

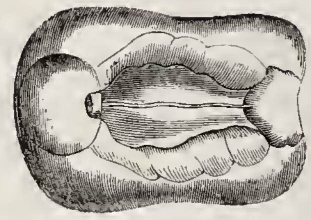


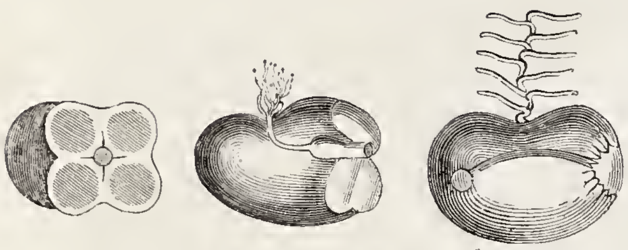
3896.—Abyla trigona


3904.—Noctiluca miliaris.

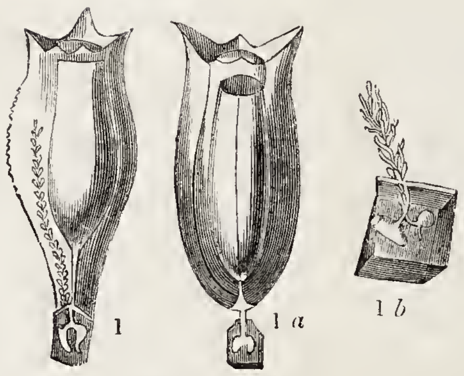


3894.—Amphiroa alata.

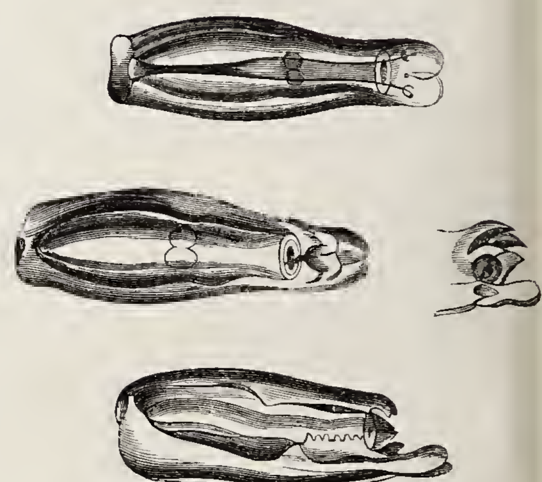

3899.—Praia dubia.

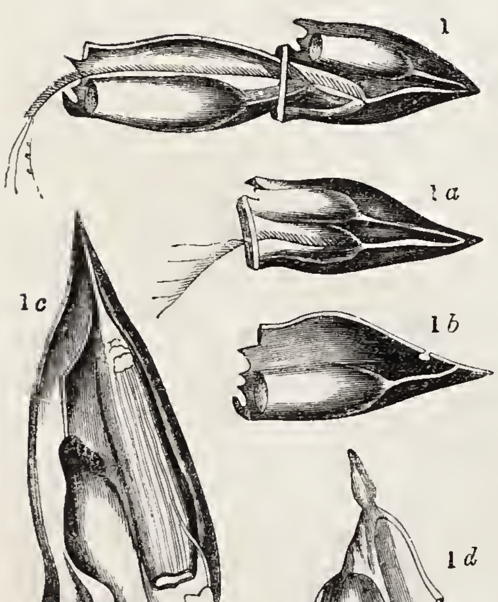

3903.—Rosacea Ceutensis.


3898.—Pyramis tetragona.

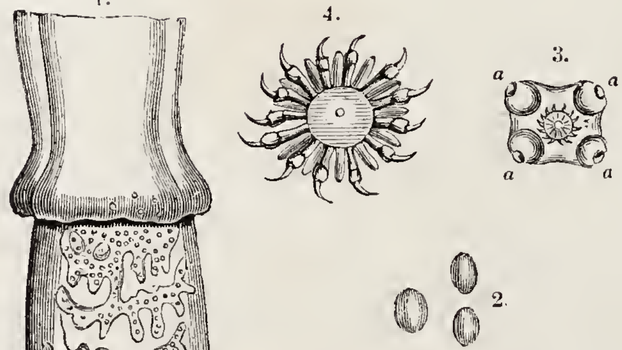


3895.—Calpe pentagona.

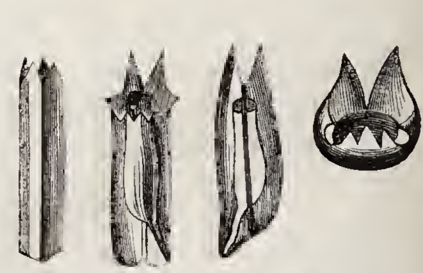

3901.—Sulculeolaria quadrivalvis.



3897.—Diphyes Bory.



3906.—Portions of Tapeworm.


3900.—Tetragona hispidum.

3902.—Galeolaria australis.

form of the most minute animalcules, in the secretions of animals enjoying the most healthy condition; nor know we to what point the law of organic parasitism—of life within life—is restricted.

Here then we close our descriptive survey of the 'Pictorial Museum of Animated Nature.' Our object has been to elucidate in a simple manner the grand groups of the animal kingdom,—to give a brief outline of the general organization, forms, modes of life, habits, and instincts of the varied beings with which the surface of our globe is tenanted. As we have passed from class to class, or from group to group, it has been felt that to some, much more than to others, a greater degree of interest attaches, as far at least as the general reader is concerned: yet let it be remembered, that he who would gain from the investigation of the treasures of a museum a general knowledge of the animal kingdom, and of the relationships of the leading and minor groups with each other, must advance to the scrutiny of forms which might not when isolated attract him. Having proceeded link by link through the chain of being and having obtained a comprehensive knowledge of the whole, he will be enabled with better advantage to direct his attention to the departments which invite his deeper researches, and will appreciate their affinities to other portions of the great whole.

But we have not only aimed at giving an outline of the animal kingdom; we have endeavoured to illustrate its various classes, orders, and minor groups, selecting such specimens as appeared most calculated to serve our purpose; and, where possible, entering, as far as our limits would admit, into details attractive in themselves, and well calculated not only to please and instruct, but also to lead the reflective mind to the cause of causes, the Almighty Creator, who in wisdom has formed our globe and all that live upon its surface.

On taking a review of our labours we find that there are one or two points to which we may here make additions.

In vol. i., p. 3, it is stated that no hybrids between the lion and tigress had arrived at maturity: this is not quite correct. We have received a letter stating that the first hybrid litter was produced at Windsor in Mr. Atkins's menagerie, nearly twenty years since, and that one of the same litter died within the last two years at the Liverpool Zoological Gardens (the letter is dated May 1844).

To the article Ursine Opossum, vol. i. p. 15, it may be added that it is removed into a distinct genus from Dasyurus, termed, by M. F. Cuvier, Sarcophilus. Our illustrations below represent a front view of the head of Sarcophilus ursinus, and the species.

In the same page is noticed a small marsupial animal under the title of Chæropus ecaudatus: this title "ecaudatus" (tail-less) has been cancelled, for it has been recently ascertained that the animal is furnished with a tolerably long tail like that of the Bandicoot. The species in question is Chæropus castanotis, Gray.

In vol. ii., p. 166, speaking of the Sprat, it is stated that "this fish is never cured like the herring." In a letter dated June 29, 1844, written by Mr. J. Greenfield, we are informed that at "Lowestoffe and Yarmouth thousands are cured every season just as the herrings are, and are sold by the dozen, or in bundles of 1000 each, tied up with twisted straw (and are called 'Kids'), and sometimes in small barrels. They may be obtained in the season at some of the shops in Thames Street" (London). We have never seen the fish so cured, but believe our correspondent to be quite correct. The use of the cured sprat, however, is not very general.

With respect to the scientific arrangement of the primary groups of the animal kingdom, we shall not enter into the many systems which have been proposed, but content ourselves with exemplifying only that of Cuvier, and that which we have followed.

Cuvier divides the animal kingdom into—

1. Animalia Vertebrata;—quadrupeds, birds, reptiles, and fishes.
2. Animalia Mollusca;—Cuttle-fish, Univalve shells, Bivalve shells, Tunicate mollusks, &c.
3. Animalia Articulata;—Red-blooded worms, Insects, Myriapodes, Crustacea, &c.
4. Animalia Radiata;—Asterias, Echinus, Jelly-fish, or Acalephæ, Polypes, Infusory animalcules, &c.

Ascending up the scale from the lowest forms to the highest, the arrangement we have adopted may be thus expressed.

THE ANIMAL KINGDOM.

Sub kingdoms.

ACRITA, MacLeay.
- Porifera, as Sponges.
- Polypifera, as Polype-bearing Corals, &c.
- Polygastrica, as Polygastric Animalcules.
- Acalephæ, as Jelly-fish, &c.
- Sterelmintha, or Parenchymatous Worms.

NEMATONEURA, Owen.
- Bryozoa, or Moss Corals.
- Rotifera, or Wheel Animalcules.
- Cælelmintha, or Cavitary Entozoa.
- Echinodermata, or Star-fish, &c.

HOMOGANGLIATA, Owen (ARTICULATA, Cuv.).
- Annelida, or Annelides, as the worm and leech.
- Myriapoda, as the Millepede.
- Insecta, Insects.
- Arachnida, Spider, Scorpion.
- Crustacea,—Crabs, Lobsters.

HETEROGANGLIATA, Owen (MOLLUSCA, Cuv.).
- Cirrhopoda, or Cirripeda? belonging perhaps to the previous sub-kingdom. Barnacles, Acorn-shells, &c.
- Tunicata,—Tunicate mollusks.
- Conchifera,—Bivalve mollusks.
- Brachiopoda,—Brachiopodous mollusks.
- Gasteropoda,—Univalve mollusks, as the snail, and also the shell-less slug.
- Pteropoda,—as Clio Borealis.
- Cephalopoda, or Cuttle-fish, Nautilus, &c.

MYELENCEPHALA, Owen (VERTEBRATA, Cuv.).
- Pisces, or Fishes.
- Reptilia, or Reptiles, including the order Amphibia.
- Aves, or Birds.
- Mammalia, or Quadrupeds.

As in our survey of the Mammalia we advanced from group to group, irrespective of systematic arrangement, perhaps the following summary of the Orders of that Class may prove not destitute of utility:—

Class MAMMALIA.

A. Sub-class *Placentalia*.

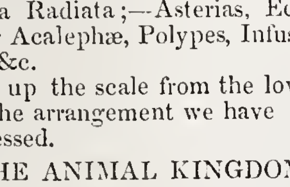
Orders.

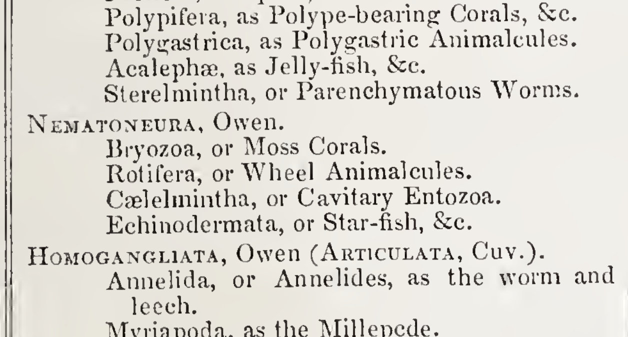
1. Bimana:—Man.
2. Quadrumana:—Apes, Monkeys, Lemurs.
3. Cheiroptera:—Bats.
4. Carnivora:—divided into
   - Felidæ:—Cat-tribe.
   - Mustelidæ:—Weasel tribe, Otters, &c.
   - Viverridæ:—Viverrine tribe, Civet, Genet, Ichneumons.
   - Hyænidæ:—Hyænas.
   - Canidæ:—Dog tribe.
   - Ursidæ:—Bear tribe.
   - Phocidæ:—Seals.
5. Insectivora:—Shrews, Moles, Hedgehogs,
6. Cetacea:—Whales, Grampus, Porpoise.
7. Pachydermata:—
   - Terrestrial:—Elephant, Rhinoceros.
   - Aquatic:—Dugong, Manatee, &c.
8. Ruminantia:—Oxen, Deer, Antelopes, Sheep.
9. Rodentia:—Hares, Rats, Porcupines, &c.
10. Edentata:—Sloth, Armadillo, Manis, Ant-eater.

B. Sub-class *Implacentalia* (Marsupialia, Auct.).

11. Marsupialia:—Kangaroo, Opossum, Wombat.
12. Monotremata:—Ornithorhynchus, Echidna.

In the other Classes, system is sufficiently adhered to.





INDEX TO THE PICTORIAL MUSEUM OF ANIMATED NATURE.

Sub-kingdom MYELENCEPHALA, or VERTEBRATA.

CLASS MAMMALIA.

Vol. I.

Aard-Vark (Orycteropus Capeusis), p. 182
Aard-Wolf (Proteles), 211
Abu-Harb (Antilope leucoryx), 146
Acanthion (Porcupines), 70
Acouchi, a rodent (Dasyprocta acuchi), 75
Adapis (fossil), 110
Addax (Antilope addax), 143
Æthiops torquatus (Collared White-eyelid Monkey), 35
Agoutis (Rodents, family Dasyproctidæ), 74
Agouti, Black (Dasyprocta cristata), 74
Agouti, Common (Dasyproeta acuti), 74
Aï (Sloth), 175
Aï, Collared (Sloth), 175
Alactaga (Jerboas), 58
American Lion (Puma), 7
Anoa (Anoa depressicornis), 170
Anoplotherium (fossil), 99
Anteaters (Myrmecophaga), 182
Anteater, Great (Myrmecophaga jubata), 182
Anteater, Little (Myrmecophaga didactyla), 183
Anteaters, Scaly (Manis), 183
Antelopes, 139
Antelope, Indian (Antilope Cervicapra), 142
Autelope, Sœmmering's (Antilope Sœmmeringii), 139
Aotus (Nocthora), 43
Aoudad (Capra tragelaphus), 150
Apes (Quadrumana), 26
Araguato (Ursine Howler), 42
Arctomys (Marmot), 55
Argalis (Wild Sheep), 151
Armadilloes (Loricata), 179
Arnee (Bos Arni), 171
Arvicolidæ (Voles, a family of Rodentia), 63
Aspalax (Mole-rat), 67
Ass (Equus asinus), 107
Ass, Wild, 107
Ateles (a genus of Monkeys), 39
Atherura (Porcupines), 70
Aurochs (Bison Europæus; Bos urus), 174
Axis (Cervus axis), 135
Aye-aye (Cheiromys Madagascariensis), 50

Babiroussa, 95
Baboons (Cynocephalus), 38
Badger, 218
Badger, Indian, 218
Bandicoot, long-nosed (Perameles nasuta) 15
Banxring (Tupaia), 238
Bats, 227
Bears (Ursidæ), 186
Bear, American Black (Ursus Americanus), 186
Bear, Bornean (Ursus euryspilus), 187
Bear, Brown (Ursus Arctos), 187
Bear, Grisly (Ursus ferox), 187
Bear, Malayan (Ursus Malayanus), 187
Bear, Polar (Ursus maritimus), 190
Bear, Siberian (Ursus collaris), 186
Bear, Sloth (Ursus labiatus), 187
Bear, Spectacled (Ursus ornatus), 187
Bear, Syrian (Ursus Syriacus), 187
Bear, Thibet (Ursus Thibetanus), 187
Beaver (Castor Fiber), 66
Bekr-el-Wash (Antilope bubalus), 146
Beluga or White Whale, 242
Bhunder (Rhesus Monkey), 38
Binturon (Arctitis Binturong), 191
Biscacha (Viscacha of the Pampas), 71
Bison (Oxen), 155
Bison, American (Bison Americanus), 174
Blauwbok (Antilope leucophæa), 146
Blessbok (Antilope pygarga), 139
Bobac (Arctomys Bobac), 55
Bonasus (Oxen), 155
Booted Lynx (Felis caligata), 11
Bos primigenius (fossil), 155
Bos Urus (Zubr), 155, 174
Bosch-Vark (African Woodswine, Sus larvatus), 99
Budeng (Semnopithecus Maurus), 34
Buffalo (Bos bubalus), 171
Buffalo Cape (Bos Caffer), 174
Bull-fights, Spanish, 162

Caama (Fox), 206
Cacajao (Pithecia melanocephala), 42
Cachalot, or Spermaceti Whale, 242
Callithrix (a genus of Monkeys), 43
Cambing-outan (Antilope Sumatrensis), 143
Camel, Arabian (Camelus dromedarius), 115
Camel, Bactrian (Camelus Bactrianus), 119
Canada Lynx (Felis Canadensis), 11
Canidæ (Canine race), 194
Canua (Antilope oreas), 146
Cape Leaping Hare (Pedetes Capensis), 59
Capybara, a large rodent, 75
Caracal (Felis Caracal), 11
Carnivora (Carnivorous quadrupeds), 2
Cat, the Egyptian, 7
Cat, Pampas (Felis pageros), 10
Cat, Wild, 7
Cattle, domestic, 158
Cattle, Zebu race, 167
Cavies (Caviidæ), 75
Caviidæ (Cavies, a family of Rodents), 75
Cavy, Patagonian (Dolichotis Patachonica), 75
Cebidæ (American Monkeys), 39
Cebus (Sapajous, a genus of Monkeys), 42
Cercocebus Æthiops, 35
Cercomys (a genus of Rodents), 67
Cercopithecus (a genus of Monkeys), 35
Cervidæ (the Deer tribe), 130
Cetacea (Order Whale-tribe), 239
Chackma (Baboon), 38
Chæropotamus (fossil), 99
Chæropus (Chæropus ecaudatus, Ogilby; castanotis, Gray), 15
Chameck (Spider Monkey), 39
Chamois (Antilope rupicapra), 143
Chati (Felis mitis), 10
Chaus (Felis Chaus), 11
Cheiromys (Lemuridæ), 50
Cheiroptera (Order Bats), 227
Chibi-guazu (Chati, Felis mitis), 10
Chimpanzee (Troglodytes niger), 26
Chinchilla (Chinchilla lanigera), 71
Chinchillidæ (a family of Rodents), 71
Chlamyphorus (Pichiciago), 182
Chrysochlore, Cape (Insec. quadruped), 235
Civet (Viverra Civetta), 211
Coast-rat (Bathiergus maritimus), 67
Coaita (Spider Monkey), 39
Coati (Nasua), 191
Coendou (Brazilian Porcupine), 70
Colobus (a genus of Monkeys), 34
Colobus, Full-maned (Colobus polycomos) 34
Colugo (Galeopithecus), 51
Condylure, Thick-tail (Condylura), 235
Coney of Scripture (Daman), 91
Cougar, the (Puma), 7
Couscous (Cuscus), 19
Couscous, spotted (Cuscus maculatus), 19
Couxio (Pithecia sagulata), 43
Coypu, a Rodent (Myopotamus Coypus), 70
Cricetus (Hamster), 63
Cryptoprocta (Viverrine), 211
Cuscus (Couseous), 19
Cynictis (Cynictis Steedmannii), 214
Cynocephalus (Baboons), 38

Dauw (Burchell's Zebra), 110
Daman (Hyrax), 91
Dasyproctidæ (a family of Rodents), 74
Deer (Cervidæ), 130
Deer, Fallow, 134
Deer, Red, or Stag, 134
Delphinidæ (Dolphins), 239
Delundung (Genet), 211
Dendrobius (Octodon, genus of Rodents), 67
Desman (Mygale), 231
Diana Monkey (Cercopithecus Diana), 35
Dinotherium (fossil), 111
Dipodidæ (Jerboas), 58
Dog (Canis familiaris), 194
Dog, Cape Hunting (Lycaon tricolor), 207
Dogs, Wild, 194
Dolphin (Delphinus), 239
Dormouse, Garden, or Greater (Myoxus nitela), 58
Dormouse, Common, 55
Douc Monkey, 246
Douroucouli (Nocthora trivirgata), 43
Drill (Baboore), 39
Dugong (Halicore), 238
Dzigguetai (Equus Hemionus), 107

Edentata (Order), 175
Elephant, 79
Elephant-Shrew, Cape (Macroscelides typicus), 231
Elk, American, 130
Entellus Monkey, 34
Equus (the Horse), 102
Erethiza (Porcupines), 70
Eriodes (a sub-genus of Ateles), 39
European Lynx (Felis Lynx), 11
Euryotes (a genus of Muridæ), 63

Fallow-deer, 134
Felidæ (Cat tribe), 2
Fennec (Fox), 207
Ferret, 215
Field-mouse, Long-tailed (Mus sylvaticus), 62
Field-mouse, Short-tailed (Arvicola agrestis), 247
Flying-squirrel, Rocky-mountain (Pteromys Alpinus), 54
Fox, American red, 206
Fox, Arctic, 207
Fox, Common (Canis vulpes), 206
Fox, Egyptian (Canis Niloticus), 206
Fox, Tricoloured, 207
Fox, Virginian, 207

Galeopithecus (Lemuridæ), 51
Garangan (Ichneumon), 214
Gayal (Bos Gavæus), 170
Gazelle, Ariel (Antilope Arabica), 139
Gazelle, Dorcas (Antilope Dorcas), 139
Genet (Genetta vulgaris), 211
Gerbillus (Gerbilles), 59
Gerbille, Burton's (Gerbillus Burtoni), 59
Gerbille, Indian, 59
Gerboa, Mitchell's, 59
Gibbons (Hylobates), 30
Gibbon, Agile, 30
Gibbon, Silvery (Hylobates leuciscus), 31
Gibbon, White-handed (Hylobates Lar.), 31
Giraffe (Camelopardalis Giraffa), 123
Glutton, 215
Glyptodon (Fossil Edentata), 178
Gnu (Antilope Gnu), 146
Gnu, Brindled (Antilope Gorgon), 147
Goat, Common (Varieties), 147
Goats and Sheep, 147
Gomari (Hippopotamus), 87
Gour (Bos Gour), 170
Graphiure, Cape (Graphiurus Capensis), 58
Great Armadillo (Dasypus gigas), 182
Grison (Galictis vittata), 218
Ground-Hare (Pika), 78
Ground-Squirrel, Common, 55
Guanaco (Wild Llama), 122
Guazu-bira (Cervus nemorivagus), 138
Guazu-pita (Cervus rufus), 138
Guereza (Colobus Guereza), 35
Gyall (Bos frontalis), 170
Gymnura (Gymnura insectivorus), 235

Hamster (Cricetus vulgaris), 63
Hapale (a genus of Monkeys), 46
Hare, Alpine (Lepus variabilis), 78
Hare, Calling (Pika), 78
Hare, Common (Lepus timidus), 78
Hare, Irish (Lepus Hibernicus), 78
Hare, Syrian, 78
Harp-Seal (Phoca Grœnlandica), 222
Hartebeest (Antilope Caama), 146
Hartebeest, Bastard (Antilope lunata), 146
Harvest Mouse (Mus Messorius), 63
Hedgehog, 235
Hippopotamus, 87
Hog, Domestic, 98
Hog, Papuan, 99
Hog, Wild, 98
Hoonuman (Entellus Monkey), 34
Horse, 102
Horse, fossil remains of, 110
Horse-shoe Bat, Splendid, 230
Horse-shoe Bat, Three-toothed, 230
Howler, Ursine (Mycetes ursinus), 42
Howling-Monkeys (Mycetes), 39
Hyæna, Spotted, 210
Hyæna, Striped, 210
Hyæna, Villose, 211
Hybrid, Pretended, of Dog and Bear, 190
Hydrochœrus capybara (Cavies), 75
Hydromys, an aquatic rodent, 63
Hylobates (Gibbons), 30
Hypsiprymnus (Kangaroo Rat), 19
Hyrax (Daman), 91
Hyrax, Cape (Hyrax Capensis), 94
Hyrax, Syrian (Hyrax Syriacus), 94
Hystricidæ (Family of Porcupines), 70

Ibex (Capra Ibex), 150
Ichneumon, Egyptian, 214
Ichneumon, Indian, 214
Indris, Short-tailed (Lichanotus brevicaudatus), 47
Insectivora (Insect-eating Quadrupeds), 231
Isodon (Capromys, a genus of Rodents), 70

Jacchus (Hapale), 46
Jackal, 206
Jaguar, 7
Javelin-Bat, Crenulated, 227
Javelin-Bat, Greater, 227
Jerboas (Dipodidæ), 58
Jerboa, Cape (Pedetes Capensis), 59
Jerboa, Dark-banded, 58
Jerboa, Egyptian (Dipus Ægyptius), 58
Jumping-Mouse, Labrador (Meriones Labradoricus), 58

Kahau (Proboscis Monkey), 34
Kalong (Bats), 230
Kanchil (Moschus Kanchil), 127
Kangaroo, Great (Macropus major), 18
Kangaroo Rat (Hypsiprymnus murinus), 91
Keitloa (Rhinoceros Keitloa), 91
Kerodon (Cavies), 75
Khur (Wild Ass), 107
Kiang (Wild Ass), 107
Kidang, or Muntjak (Cervus Muntjak), 138
Kinkajou (Cercoleptes caudivolvulus), 191
Kleenbok (Antilope perpusilla), 143
Koala (Phascolarctos cinereus), 22
Koba or Sing-Sing (Antilope Koba), 143
Kokoon (Antilope taurina), 147
Koodoo (Antilope strepsiceros), 146
Koulan (Wild Ass), 107

Lagostomus (a genus of Rodents), 71
Lagotis (a genus of Rodents), 71
Lagotis, Cuvier's (Lagotis Cuvieri), 71
Lamantin (Manatee; Manatus), 238
Lemuridæ (Lemurs), 46
Lemurs, 46
Lemur, Diadem (Propithecus diadem), 47
Lemur, Flocky (Lemur laniger), 47
Lemur, Ruffed (Lemur Macaco), 47
Lemur, White-fronted (Lemur albifrons), 47
Leopard, 6
Leporidæ, Hares & Rabbits (Fam. Rodents), 78
Lion, 2
Lipurus (Phaseolarctos), 22
Llama (Auchenia), 122
Lophiodon (fossil), 95
Loris, slender (Stenops gracilis), 47
Loris, slow-paced (Stenops tardigradus), 47
Lynxes, 10

Macacus (a genus of Monkeys), 35
Macaque, Radiated (Macacus radiatus), 38
Macropus (Kangaroo), 18
Madoqua (Antilope Saltiana), 142
Maimon (Rhesus Monkey), 38
Mammoth (Fossil Elephant), 86
Manatee, 238
Mandrill (Baboon), 38
Mangabey à collier, 35
Mangue (Crossarchus obscurus), 214
Manis, Long-tailed (Manis longicaudata) 183
Manis, Short-tailed (Manis brachyura), 183
Manis, Temminck's (Manis Temminckii) 183
Mara (Patagonian Cavy), 75
Marikina (Silky Tamarin), 46
Marimonda (Spider Monkey), 39
Marmot, Alpine (Arctomys marmota), 55
Marmot, Podolian (Mole-rat), 67
Marmot, Quebec (Arctomys empetra), 55
Marmozets (Hapale), 46
Marmozet, Common (Hapale Jacchus), 46
Marsupialia, Marsupial quadrupeds, 14
Marsupials, Fossil, 23
Marten (Beech and Pine), 215
Mastodon, 87
Mataco (Armadillo, Dasypus apar), 179
Megaderma, Trifoliated (Bats), 230
Megalonyx (Fossil Edentate), 179
Megatherium (Fossil Edentate), 178
Meminna (Moschus Meminna), 127
Merian's Opossum (Didelphis dorsigera), 14
Meriones (Jumping Mouse), 58
M'horr (Antilope M'horr), 142
Midas (Hapale), 46
Miriki (Spider Monkey), 39
Moholi (Galago Moholi), 50
Mole (Talpa), 234
Mole-rat (Aspalomys Typhlus), 67
Molossus, Dusky (Bats), 230
Molucca Bat, Pallas's, 230
Mona-Monkey (Cercopithecus mona), 35
Monkeys, 31
Monkeys, American (Cebidæ), 39
Monkey, Black-crested (Semnopithecus melalophus), 34
Monkey, Collared White-eyelid, 35
Monkeys, Fox-tailed (Pithecia), 42
Monkey, Green (Cercopithecus sabæus), 35
Monkey, Jacketed (Pithecia sagulata), 43
Moose-deer (American Elk), 130
Morse (Walrus), 226
Moschidæ (Family of Ruminants), 127
Mouflon (Wild Sheep), 151
Mouse, Barbary (Mus Barbarus), 62
Mouse, Common (Mus musculus), 59
Mouse, Darwin's (Mus Darwinii), 62
Mouse, Economist (Arvicola œconomus), 63
Mouse, Harvest (Mus messorius), 63
Mouse, Long-tailed Field (Mus sylvaticus), 62
Mus pumilio (Barbary Mouse), 62
Mule, 110
Muntjaks, or Chevrotains, 138
Muridæ (Mouse family), 59
Musk-deer (Moschus moschiferus), 127
Musquash (Ondatra zibethica), 66
Mustelidæ (Weasels), 214
Mycetes (a genus of Monkeys), 39
Mylodon (Fossil Edentate), 178
Myoxidæ (Dormice), 55
Myrmecobius, Banded (M. fasciatus), 18

Napu (Moschus Javanicus), 127
Narwhal (Monodon), 239
Nocthora (a genus of Monkeys), 43
Noctilio, Leporine (Bats), 230
Nutria, a fur-bearing Rodent (Coypu), 70
Nycteris, Geoffroy's (Bats), 230
Nyctipithecus (Nocthora), 43
Nyl-ghau (Antilope picta), 143

Ocelot (Felis pardalis), 10

Octodon, Cuming's (Octodon Cumingii), 67
Onager (Wild Ass), 107
Ondatra (Musquash), 66
Opossums, 14
Orang-outan (Pithecus satyrus), 27
Ornithorhynchus, 22
Orycteropus (Aard-vark), 182
Orycterus (Coast-rat), 67
Oryx (Antilope Oryx), 146
Otter (Lutra vulgaris), 219
Otter, Sea (Enhydra marina), 222
Ounce, 6
Ox, Musk (Ovibos moschatus), 174
Ox, White; wild ox of ChillinghamPark,158
Oxen (Bos), 155
Oxen, fossil relics of, 158

Paca, Dusky, a rodent, 74
Pacas (Rodents, Fam. Dasyproctidæ), 74
Pachydermata (Order), 79
Pachydermata, Aquatic, 238
Pachydermata, Fossil, Remarks upon, 114
Paco (Auchenia Alpaca), 123
Palæotherium (fossil), 95
Palatine (Diana Monkey), 35
Pallah (Antilope melampus), 142
Pampas Cat (Felis Pajeros), 10
Panda (Ailurus fulgens), 191
Pangolin (Manis), 183
Panther, 6
Paradoxure (Paradoxurus Typhus), 214
Parry's Spermophile (Spermophilus Parryi), 55
Paseng (Capra ægagrus), 150
Peba (Armadillo, Dasypus Peba), 179
Peccary, Collared (Dicotyles torquatus), 95
Peccary, White-lipped (Dicotyles labiatus), 95
Pekan or Fisher (Mustelidæ), 215
Perameles (Bandicoot), 15
Petaurus, 19
Phacochœre, Abyssinian, 99
Phacochœre, South African (Phacochœrus Æthiopicus, 99
Phacochœrus, 99
Phalangers (Phalangista), 19
Phalanger, Vulpine (Phalangista vulpina), 19
Phalanger, Flying (Petaurus), 19
Phalangista, 19
Phascogale, Brush-tailed (Phascogale penicillata), 15
Phascolomys (Wombat), 22
Phascolarctos, 22
Phocidæ (Seals), 222
Pichiciago (Chlamyphorus truncatus), 182
Pichy (Armadillo, Dasypus minutus), 182
Pika, Dwarf, rodent (Lagomys pusillus), 78
Pithecia (Sakis, a genus of Monkeys), 42
Pithecus (Orang), 27
Pithecus Abellii (Sumatran Orang), 27
Pithecus Morio, 27
Pithecus Wormbii (Bornean Orang), 27
Platypus (Ornithorhynchus), 22
Polecat, 215
Pongo (Pithecus), 27
Porcupine, Brazilian (Synetheres prehensilis), 70
Porcupine, Canada (Erethizon dorsatum), 70
Porcupine, Common (Histrix cristata), 70
Porcupine, Hairy (Canada Porcupine), 70
Porcupine, prehensile (Brazilian Porcupine), 70
Porpoise, 239
Potoroo (Kangaroo-rat), 19
Pouched Rat, Camas (Diplostoma bulbivorum), 67
Poyou (Armadillo, Weasel-headed; Dasypus, Encoubert), 179
Proboscis Monkey (Semnopithecus larvatus), 34
Prongbuck (Antilope furcifer), 143
Propithecus Diadema, 47
Proteles cristata (Aard-Wolf), 211
Pteromys (Flying-squirrel), 54
Pteropus, Amboyna (Bats), 230
Puma, 7

Quadrumana (Apes, Monkeys, Lemurs), 26
Quadrumana, Fossil, 51
Quagga (Equus Quagga), 110

Rabbit (Lepus cuniculus), 78
Rabbit, Cercomys (Rodentia), 67
Racoon (Procyon Lotor), 190
Racoonda, a fur-bearing rodent (Coypu), 70
Rasse (Genet), 211
Rat, Black (Mus Rattus), 59
Rat, Brown, or Norway (Mus decumanus), 59
Rat, Caffre Broad-eared (Euryotis unisulcatus), 63
Rat of Ascension Island, 59
Rats, Spiny (Echymys), 67
Rat, Water (Arvicola amphibia), 66
Ratel (Ratelus), 218
Ratel, Indian, 218
Rein-deer, 131
Reitbok (Antilope eleotragus), 142
Rhesus (Macacus Rhesus), 38
Rhinoceros, 90
Rhinoceros, Blunt-nosed, or White, 91
Rhinoceros, Common African, 90
Rhinoceros, Indian, 90
Rhinoceros, Javanese, 90
Rhinoceros Keitloa, 91
Rhinoceros, Sumatran, 90
Rimau Dayan (Felis macroscelis), 6
Rodentia (Order of Rodent Quadrupeds), 54
Roebuck (Cervus Capreolus), 138
Roloway (Diana Monkey), 35
Rorqual (Whale), 246
Ruminantia (Order), 115

Saimiri (Callithrix sciureus), 43
Sais (Sapajous), 42
Sajous (Sapajous), 42
Sajou, Brown (Cebus Apella), 42
Sajou, Horned (Cebus fatuellus), 42
Sajou, Yellow-breasted (Cebus xanthostenos), 42
Sakis (Pithecia, a genus of monkeys), 42
Saki, White-headed (Pithecia leucocephalus), 43
Sambur (Cervus Hippelaphus), 135
Sand-hog (Indian Badger), 218
Sand-rat, Canada (Geomys bursarius), 67
Sapajous (Cebus, a genus of monkeys), 42
Scelidotherium (fossil Edentate), 178
Sciuridæ (Family of Squirrels), 54
Sea-cow (Hippopotamus), 87
Sea-leopard (Seal), 223
Sea-lion, Forster's (Seal), 226
Seal, Common (Phoca vitulina), 222
Seal, Crested (Stemmatopus cristatus), 223
Seal Elephant, Macrorhinus proboscideus, 228
Seal, Ursine (Arctocephalus ursinus), 223
Semnopithecus (genus of monkeys), 31
Sheep, Domestic (Varieties), 151
Sheep, Wild, 150
Shrew, 231
Shrew-mole (Scalops), 234
Siamang (Hylobates syndactylus), 31
Simpai (Black-crested monkey), 34
Skunk (Mephitis), 218
Sloths, 175
Sloth, Common (Bradypus tridactylus), 175
Solendon (Insectivorous quadruped), 231
Souslik (Spermophilus), 55
Spalax (Mole-rat), 67
Spider Monkeys (Ateles), 39
Springbuck (Antilope Euchore), 142
Steinbok, or Bouquetin (Ibex), 150
Stenops (Loris), 47
Squirrels, 54
Squirrel, Malabar (Sciurus maximus), 54
Squirrel-monkey (Saimiri), 43
Squirrel, Northern Grey and Black, 54
Squirrel-Petaurus (Petaurus sciureus), 19
Stag, or Red-deer, 134
Stoat, 215
Suidæ (Family of Hogs or Hog tribe), 95
Suricate (Ryzæna tetradactyla), 211
Synetheres (Porcupines), 70

Tamandua (Ant-eater), 183
Tamanoir (Great Ant-eater), 182
Tamarin (Silky Marmozet, Hapale rosalia), 46
Tamias (Ground-squirrel), 55
Tangalung (Viverra Tangalunga), 211
Taphozous, Mauritius (Bats), 230
Tapir, American, 94
Tapir, Malay or Indian, 94
Tapirus (Tapirs), 94
Tapoa, Sooty (Phalangista fuliginosa), 19
Tarsier, Banca (Tarsius Bancanus), 50
Tarsius (Lemuridæ), 50
Tatouay (Armadillo, Dasypus Tatouay), 182
Teledu (Mydaus), 247
Temminck's Colobus (Colobus Temminckii), 34
Tenrec (Centetes, Insectivorous), 235
Tenrec, Spiny, or Tendrac, 235
Tenrec, Striped, 235
Thylacinus, Dog-headed (Thylacinus cynocephalus), 15
Tiger, 3
Tiger-cat, Nepaul, 6
Toque (Macacus radiatus), 38
Toxodon (fossil), 111
Troglodytes (Chimpanzee), 26
Tucotuco, a small rodent (Ctenomys Magellanicus), 67

Unau (Sloth, two-toed), 175
Ungka-etam (Gibbon), 30
Ungka-puti (Gibbon), 30
Ursine Opossum (Dasyurus ursinus), 15
Urus (Wild Ox), 155
Utia, a rodent (Capromys Fournieri), 70

Vampire Bat, 227
Vicugna (Auchenia Vicugna), 123
Virginian Opossum (Didelphis Virginiana) 14
Viscacha, Pampas, a rodent (Lagostomus trichodactylus), 71
Viscacha, Peruvian (Lagotis), 71

Walrus or Morse, 226
Wanderoo (Macacus Silenus), 38
Wapiti (Cervus Wapiti), 135
Water-mole (Ornithorhynchus paradoxus), 22
Water-rat (Arvicola amphibia), 66
Weasels, British, 215
Weepers (Sapajous), 42
Whale, Greenland, 243
Whale, Southern, 243
Whale, Spermaceti (Cachalot), 242
Wolf (Canis Lupus), 203
Wolf, American, 206
Wolf, Antarctic (Canis Antarcticus), 206
Wolf, Black (Canis Lycaon), 203
Wolf, Dusky (Canis nubilus), 203
Wolf, Prairie (Canis latrans), 206
Wolverene (Glutton), 215
Wombat (Phascolomys Wombat), 22
Woodswine of Africa, 99
Wouwou (Hylobates leuciscus), 31

Xiphodon (fossil), 99

Yak (Bos grunniens), 170
Yapock Opossum (Cheironectes palmatus), 14
Yarke (Pithecia leucocephala), 43

Zebra (Equus Zebra), 110
Zebra, Burchell's (Equus Burchellii), 110
Zebra Opossum (Thylacinus), 15
Zebu (Cattle), 167
Zeuglodon, fossil teeth of, 238
Zibet (Viverra Zebitha), 211
Zizel (Spermophilus), 55
Zorille (Mustelidæ), 218

CLASS AVES (BIRDS).

Aberdivine (Siskin), 334
Ampelidæ (Family of Chatterers), 306
Ani (Cuculidæ), 359
Araçari, Curl-crested, 355
Araçari, Humboldt's, 355
Araçari, Many-banded, 355
Asturina, Grey (Eagles), 263
Aves (Class Birds), 250

Barbet, Bristly, 370
Barn-owl (Strix flammea), 282
Beccafico (Garden Warbler), 315
Bee-eater (Merops apiaster), 299
Benteot (Corvidæ), 343
Birds, Class Aves, 250
Birds, Structure of, 250, 254
Bird of Paradise, Emerald, 347
Bird of Paradise, Golden, 346
Bird of Paradise, Incomparable, 346
Bird of Paradise, King, 346
Bird of Paradise, Magnificent, 347
Bird of Paradise, Superb, 346
Blackbird, 323
Black-cap, 315
Black-cap, Titmouse of America, 311
Blue-bird, 318
Breve, Giant (Merulidæ), 327
Buceridæ (Family of Hornbills), 350
Bullfinch, 334
Bullfinch, Arabian, 334
Bullfinch, Blue, 335
Bullfinch, Thick-billed, 335
Bunting, Common, 331
Bunting, Reed, 331
Buphagidæ (Family of Pique-Bœufs), 342
Burung-Biru (Alcyonidæ), 298
Bush-shrike, Spotted, 306
Bush-shrike, Vigors's, 306
Butcher-bird, 303
Buzzards, Common, Honey, 274

Canary-finch, 334
Capercaillie, Capercailzie, Cock of the Wood, 398
Caprimulgidæ (Family of Night-jars or Goat-suckers), 286
Calyptomena viridis, 307
Caracara, Brazilian (Eagles), 262
Cedar-bird, 307
Certhiadæ (Family of Creepers), 366
Ceyx Luçon (Alcyonidæ), 298
Chaffinch, 334
Chatterer, Bohemian, 307
Chatterer, Japanese, 310
Chuck-will's-widow (Caprimulgidæ), 287
Cinnyridæ (Family of Sun-birds), 37
Circaëtus, Short-toed (Eagles), 263
Climacteris (Certhiadæ?), 367
Cock of the Rock, 306
Cock of the Rock, Peruvian, 306
Cock of the Plains (Grouse), 399
Cockatoo, Great Sulphur-crested, 366
Cole-tit, 311
Coliadæ (Family of Colies or Mouse-birds, 350
Coly, Senegal, 350
Condor, 279
Coracinidæ (Family of Fruit-Crows), 306
Corvidæ (Family of Crows), 342
Cotinga, Scarlet, 310
Couroucous (Trogons), 299
Cow-troopial (Sturnidæ), 339
Crab-eater, Cinnamon (Halcyonidæ), 295
Creeper, Common, 366
Creeder, Curve-billed, 367
Creeper, Familiar (Sylviadæ), 319
Creeper, Wall, 367
Cross-bill, 335
Crow, Bald-headed, 346
Crow, Philippine, 343
Crow, Piping, 342
Crow, Royston or Hooded, 343
Crypsirina (Corvidæ), 343
Cuculidæ (Family of Cuckoos), 358
Cuckoo, 358
Cuckoo, Gilded, 359
Cuckoo, Le Vaillant's, 359
Cuckoo, Yellow-billed, 359
Cymindis, Cayenne (Eagles), 263
Cymindis, Hook-billed (Eagles), 263

Daptrius, Black (Eagles), 262
Diamond-Bird (Pardalotus punctatus), 310
Eagle, Bacha (Hæmatornis, 259
Eagle, Brazilian, or Urubitinga, 263
Eagle, Golden (Aquila chrysaëtos), 255
Eagle, Harpy (Harpyia destructor), 259
Eagle, Imperial (Aquila imperialis), 258
Eagle, White-headed (Haliæetus leucocephalus), 258
Ephthianura, White-fronted (Sylviadæ), 322
Epimachus, Superb (Promeropidæ), 379
Euphemia, Undulated (Parrakeet), 363
Eurylaimus, Javanese (Todidæ), 295

Falcons (Peregrine Falcon), 266
Falcon, Bengal, 270
Falconidæ (Family of Eagles, Falcons, Hawks), 255
Fieldfare, 323
Flycatcher, Fantailed, 303
Flycatcher, Pied, 303
Flycatcher, Spotted, 303
Flycatcher, Nest of a species, 303
Fork-tail, Java (Sylviadæ), 319
Fowl, Domestic, 390
Fowls, modes of hatching artificially, 391
Fringillidæ (Family of Finches), 330
Fruit-Crow, bald, 306
Fruit-Crow, bare-necked, 306
Fruit-Crow, Scaled, 306
Fruit-Pigeon, Oceanic, 387

Glead (Kite), 271
Goatsucker (Nightjar or Churn-owl), 286
Goatsucker, Fork-tailed, 290
Gold-crest (Regulus), 382
Goldfinch, 334
Goshawk, 271
Grakle, Paradise (Corvidæ), 346
Greenfinch, 335
Griffon Vulture, 278
Ground-Pigeon, Wattled, 390
Grouse, Black, 398
Grouse, Dusky, 399
Grouse, Pinnated, 399
Grouse, Ruffed, 399
Guacharo (Caprimulgidæ), 287
Guinea-fowl (Pintado), 398
Guinea-fowl, Crested, 398
Gypogeranus (Secretary Bird), 263
Gyratores (Order, with Pigeons), 383

Hæmatornis (Eagles), 259
Halcyonidæ (Family of King-fishers), 295
Harpagus, Bidentate (Hawks), 271
Harriers (Birds of Prey), 275
Hawfinch, 335
Hawks, 270
Hawk, Chanting, 271
Hawk, Laughing, 271
Hawk, Swallow-tailed, 274
Hawk-owl, 282
Hirundinidæ (Family of Swallows), 290
Honey-buzzard, 274
Honey-eater, New Holland (Melliphaga), 379
Honey-guide, 359
Honeysucker, Blue-headed, 379
Hoopoe, 351
Hornbill, Concave, 351
Hornbill, Rhinoceros, 351
Humming-birds, 375, 378
Humming-bird, Barb-tailed, 379
Humming-bird, Cora, 379
Humming-bird, Double-crested, 378
Humming-bird, Gould's, 379
Humming-bird, Recurved-bill, 379
Humming-bird, Red-throated, 378
Humming-bird, Sickle-winged, 379

Ictinia, Lead-coloured (Kites), 274
Ibijau, Great (Caprimulgidæ), 286
Ibycter, Aquiline (Eagles), 262
Insessores (Order of Perching Birds), 2 6

Jacamar, Paradise, 298
Jay, American Blue; and European, 343
Jungle-fowl, Bankiva, 391
Jungle-fowl, Fin-backed, 391
Jungle-fowl, Sonnerat's, 391

Kestrel (Falco tinnunculus), 270
Kingfisher, Belted, 295
Kingfisher, Common, 295
Kingfisher, Gigantic, 295
Kingfisher, Great Senegal, 298
Kingfisher, Sacred, 298
Kingfisher, Ternate, 298
King-Vulture, 279
Kites, 271
Kite or Glead, 271

Lammergeyer (Gypaëtus barbatus), 259
Lamprotila, Broad-billed (Alcyonidæ), 298
Laniadæ (Family of Shrikes), 303
Lark, 330
Linchi (Esculent Swallow), 294
Linnet, Common, 334
Loriet, Tabuan, 363
Lorikeet, Blue Mountain, 366
Lory, Purple-capped, 366
Love-Birds, 366
Lyre-Bird (Menura superba), 330

Macaw, Blue and Yellow, 362
Magpie, 346
Manakin, Crested, 310
Manakin, Red and Black, 310
Marsh-Tit, 311

Merlin (Falco æsalon), 270
Martin, Purple, 294
Martin, Sand, 291
Martin (Window Swallow), 291
Melliphagidæ (Family of Honey-eaters), 379
Menuridæ (Family of Lyre-Birds), 327
Meropidæ (Family of Bee-Eaters), 299
Merulidæ (Family of Thrushes), 322
Mino-bird, 342
Mino-bird, Java, 342
Mocking-Bird, 326
Moor-Harrier (Circus æruginosus), 275
Morphnus, Crested (Eagles), 263
Motmot, Mexican, 298
Muscicapidæ (Family of Flycatchers) 303
Musophagidæ (Family of Plantain-eaters) 350
Myophone, Yellow-billed (Corvidæ), 342

Nacunda (Caprimulgidæ), 290
Nectariniadæ (Family of Honey-suckers), 379
Nests of Various Warblers), 319
Night-hawk (Caprimulgidæ), 286
Night-jar (Goatsucker), 286
Night-jar, African Long-tailed, 290
Night-jar, Leona, 290
Night-feeder, Red-breasted (Meropidæ), 299
Nightingale, 314
Nutcracker, 346
Nuthatch, 367
Nymphicus, New Holland (Parrakeet), 363

Oriole, Baltimore (Sturnidæ), 339
Oriole, Golden, 326
Orthonyx, Spine-tailed (Certhiadæ ?), 367
Ortolan, 331
Osprey, Fish-hawk (Pandion Haliætus), 258
Owl, Burrowing, 283
Owl, Great, 283
Owl, Ural, 282
Owl, Virginian Hornet, 283
Ouzel, Water, 327
Oven-Bird (Furnarius. Certhiadæ ?), 367

Paradiseidæ (Family Birds of Paradise), 346
Paridæ (Family of Tits or Titmice), 310
Parrakeet, Alexandrine, 363
Parrakeet-Macaw, Red-fronted, 363
Parrakeet, Rose-ringed, 363
Parrots, 362
Parrot, Long-billed, 366
Peacock (Pavo cristatus), 395
Peacock, Japan, 395
Peacock, Javanese, 395
Peacock-pheasant, Crested, 395
Peacock-pheasant, Thibet, 395
Peregrine Falcon, 266
Peristera, Brown-backed (Pigeon), 390
Pettichaps, Greater (Garden Warbler), 315
Pharaoh's Chicken (Egyptian Vulture), 275
Phasianella (Pigeon), 387
Pheasant, Argus, 394
Pheasant, Common, 394
Pheasant, Golden, 394
Pheasant, Hastings' Horned, 394
Pheasant, Impeyan, 394
Pheasant, Reeve's, 394
Pheasant, Silver, 394
Pheasant, Temminck's Horned, 394
Phytotomidæ (Family of Plant-cutters), 350
Piahau, Common (Shrikes), 306
Picidæ (Family Woodpeckers, Barbets), 370
Pie, Trimmed, 346
Pie, Wandering, 343
Pigeons, 383
Pigeon, Bronze-winged, 390
Pigeon, Chestnut-shouldered, 386
Pigeon, Crowned, 390
Pigeon, Double-crowned, 386
Pigeon, Ground, 390
Pigeon, Manasope, 387
Pigeon, Nicobar, 390
Pigeon, Passenger, 386
Pigeon, Talpicote, 390
Piroll, Sea-green (Merulidæ), 327
Pipit, Meadow, 322
Pipit, Tree, 322
Pipridæ (Family Cotingas, Manakins), 310
Pique-Bœuf, Red-billed, 342
Pit-pit (Sturnidæ), 339
Plant-cutter, Chilian, 350
Plantain-eater, Violet, 350
Podargus, Cold-river, 290
Podargus, Javanese, 290
Podargus, Long-eared, 290
Podargus, Papuan, 290
Podoces, Panders (Corvidæ), 346
Poe Bird (Melliphagidæ), 379
Poultry, Domestic, 390
Promeropidæ (Family of Promeropes), 379
Promerops, Red-billed, 379
Psittacidæ (Family of Parrots), 362
Psittacule, Taranta, 366
Puff-bird, Great-billed, 370

Raptores (Order, Birds of Prey), 255
Rasores (Order of Birds, including Poultry, Pheasants, Partridges, &c.), 390
Raven, 342
Redbreast, 318
Redstart, 322
Redstart, Blue-throated, 318
Redwing, 323
Rhamphastidæ (Fam. Toucans, Araçaris) 354
Rice Troopial (Sturnidæ), 339
Ring-dove, or Cushat, 383
Ring-ouzel, 328
Rock-dove, 383, 386
Roller, 299
Roller, Abyssinian, 299
Rook, 343

Salangane (Esculent Swallow), 294
Satin-bird (Corvidæ), 342
Scansores (Scansorial Order of Birds), 354
Secretary (Bird of Prey), 263
Sedge-warbler (Sylviadæ), 318
Shortwing, Mountain (Warblers), 315
Shrike, Cayenne, 306
Shrike, Cunningham's, 306
Siskin (Aberdivine), 334
Skylark, 380
Snow-bird, 331
Sparrow, Baya (Toddy-bird), 333
Sparrow, Java, 335
Sparrow, Song, 334
Sparrow-hawk, 271
Starling, 342
Stock-dove, 383
Stone-chat, 322
Strigidæ (Family of Owls), 282
Sturnidæ (Family of Starlings), 339
Sun-bird, Collared, 379
Sun-bird, Javanese, 379
Swallow, 290
Swallow, American Barn, 291
Swallow, Cliff (Republican Swallow), 291
Swallow, Esculent, 294
Swallow, Fruit-eater, 310
Swallow, Large-winged, 294
Swallow, White-banded, 294
Swallow-hawk, Black-winged, 274
Swallow-roller, Oriental, 299
Swift, 294
Swift, Large-winged, 294
Sylviadæ (Family of Warblers), 314
Synallaxis, Garrulous (Sylviadæ), 318

Tanager, Scarlet (Summer Red-Bird), 331
Tetraonidæ (Family of Grouse), 398
Thrush, Ground-scraping, 323
Thrush, Hermit, 323
Thrush, King, 327
Thrush, Missel, 323
Thrush, Red-breasted, 323
Thrush, Song, 322
Thrush, Wood (Tawny Thrush), 323
Timalia, Chestnut-capped (Merulidæ), 327
Tit, Greater, 310
Titmice, British, 310
Titmouse, Bearded, 314
Titmouse, Black, 314
Titmouse, Blue, 311
Titmouse, Long-tailed, 311
Titmouse, Penduline, 314
Titmouse, Yellow-cheeked, 310
Toddy-Bird (Baya Sparrow), 339
Todidæ (Family of Todies), 295
Tody, Green, 295
Toucan, Cuvier's, 355
Toucan, Toco, 355
Touraco, Crested (Musophagidæ), 350
Touraco, Senegal (Musophagidæ), 350
Touraco, Variegated, 350
Trochilidæ (Fam. of Humming-birds), 375
Trogonidæ (Family of Trogons), 299
Trogon Diardii, 302
Trogon Mexicanus, 302
Trogon Narina, 302
Trogon Pavoninus, 302
Trogon Reinwardtii, 302
Trogon Resplendens, 302
Trogon Temnurus, 302
Turkey, 395
Turkey, Honduras, 398
Turkey-buzzard (Vulture), 278
Turtle, Collared (Dove), 386
Turtle-dove, 383, 386

Umbrella-bird, 306
Upupidæ (Family of Hoopoes), 351

Vinago, Aromatic (Pigeon), 387
Vulture, Black, 278
Vulture, Chinese, 278
Vulture, Cinereous, 278
Vulture, Egyptian, 275
Vulture, Indian, 279
Vulture, King, 279
Vulture, Kolbe's, 278
Vulture, Pondicherry, 278
Vulture, Sociable, 278
Vulturidæ (Family of Vultures), 275

Wagtail, Pied, 318
Wagtail, White, 318
Wagtail, White-winged, 318
Warbler, Dartford, 322
Warbler, Garden (Greater Pettichaps), 315
Warbler, Grey-backed, 318
Warbler, Kentucky, 319
Warbler, Yellow-crowned (Myrtle-bird), 322
Weaver-bird, Sociable, 338
Weaver-bird, Mahali, 338
Weaver-bird, Red-billed, 338
Weaver-bird, Taha, 338
Weaver-bird, Yellow-crowned, 338
Weaver-bird, Yellow-headed, 338
Wheatear, 315
Whidah-bird, Paradise, 335
Whidah-bird, Red-billed, 335
Whinchat, 315
Whip-poor-will (Caprimulgidæ), 287
White-throat, 315
Wood-lark, 331
Woodpecker, Caffre, 375
Woodpecker, Chilian, 374
Woodpecker, Downy, 371
Woodpecker, Great Black, 370
Woodpecker, Great Spotted, 374
Woodpecker, Green, 374
Woodpecker, Hairy, 371
Woodpecker, Ivory-billed, 371
Woodpecker, Lesser spotted, 374
Woodpecker, Red-headed, 371
Woodpecker, Three-toed, 374
Woodpecker, Yellow-bellied, 371
Wood-swallow, Cinereous, 382
Wood-swallow, Common, 382
Wood-wren (Sylvia sylvicola), 383
Wren, Common, 382
Wryneck, 375

Yellow-Hammer, 331
Yellow-throat, Maryland (Sylviadæ), 319

BIRDS—*continued.*

Vol. II.

Adjutant, or Argala, 35
Albatross, 63
Alcadæ (Family of Auks, Guillemots, Puffins), 58
Alecthelia Urvillii (young of Duperrey's Megapode), 10
Anatidæ (Family of Ducks, Swans, &c.), 39
Apterygidæ (Family, including the Apteryx), 11
Apteryx (Kiwi-Kiwi), 11
Ardeidæ (Family of Herons, Storks, &c.), 31
Auk, Great, 58
Auk, Parakeet, 59
Auk, Little, or Rotch, 58
Auk, Razor-bill, 58
Avocet, 26

Bittern, 34
Boatbill, 34
Booby, or Brown Gannet, 67
Bustard, Black-headed, 15
Bustard, Great, 15
Bustard, Kori, 15

Cariama, 30
Cassowary, 11
Charadriadæ (Family of Plovers), 15
Chuck-will's-widow, 71
Colymbidæ (Family of Divers), 55
Coot, 26
Cormorant, 70
Cormorant, Crested, 70
Cracidæ (Family of Curassows), 6
Crake, Corn, 27
Crake, Spotted, 27
Crane, Common, 31
Crane, Crowned, 31
Crane, Numidian (or Demoiselle), 31
Crane, Stanley, 31
Curassow, Crested, 6
Curassow, Galeated, 6
Curlew, 19
Curlew, Stone (Thick-knee), 18
Cursores (Order of Birds), 10

Darter, American, 70
Darter, Le Vaillant's, or Snake-bird, 70
Dididæ (Family, including the Dodo), 14
Diver, Northern, 55
Dodo (Dronte, Dod-aers, Solitario), 14
Dotterel, 18
Duck, Eider, 47
Duck, Long-tailed, 50
Duck, Mandarin, 47
Duck, Pin-tailed, 46
Duck, Spirit (or Buffle-headed Duck), 50
Duck, Steamer (Racehorse), 50
Duck, Summer, 47
Duck, Surf (or Surf-Scoter), 47
Duck, Wild, or Mallard, 43
Dunlin, or Purre, 23
Dunlin, Minute (Little Sandpiper), 23

Egyptian Antiquities; Quadrupeds and Birds represented upon, 71
Emeu (Emu, and New Holland Cassowary), 11

Flamingo, 38
Flamingo, Little, 39
Francolin, Ferruginous and Grey, 3
Francolin, Pileated, 3
Frigate, or Man-of-War Bird, 71

Gadwall, 43
Gallinule, Hyacinthine, 27
Gannet, or Solan Goose, 67
Gannet, Brown, or Booby, 67
Godwit, Black-tailed, 19
Godwit, Red, or Common, 22
Goosander, 54
Goose Bean, 51
Goose, Bernicle, 51
Goose, Canada, 50
Goose, Cereopsis, 54
Goose, Egyptian, 51
Grallatores (Order of Wading-Birds), 15
Grebe, Eared; Redneck; Crested; Horned; and Little, or Dabchick, 55
Grouse, Red, 2
Guan, Crested, 6
Guan, Motmot, 6
Guillemot, Black, 58
Guillemot, Foolish, 58
Gull, Arctic; Skua, 66
Gull, Black-headed, or Laughing, 66
Gull, Great Black-backed, 66
Gruidæ (Family of Cranes), 30

Heron, Common, 31
Heron, Night, 34
Hoatzin (Opisthocomus cristatus), 6
Honey-eater, Warty-faced, 71
Hooper, or Whistling Swan, 42

Ibis, Glossy, 35
Ibis, Sacred, 35
Jabiru, 35
Jacana, Common, 30
Jungle-fowl of the Colonists of Port Essington (Megapode), 7

Kiwi-kiwi (Apteryx), 11
Knot (Aberdeen, and Red Sandpiper), 23

Lapwing (Peewit), 18
Laridæ (Family of Gulls, Terns, &c.), 63
Leipoa, Ocellated, 6

Mallard, or Wild Duck, 43
Man-of-War Bird (Frigate Bird), 71
Marabou, 35
Megapode, Duperrey's, 10
Megapode, Mound-making, 7
Megapodidæ (Family of Megapodes), 6
Moorhen, 27
Nandu (Rhea), 10
Natatores (Order of Swimming-Birds), 39
Noddy, 66

Ostrich, 10
Otidæ (Family of Bustards), 15
Oyster-catcher, 19

Palamedeidæ (Family of Jacanas, Screamers, &c.), 30
Partridge, Californian (Ortyx), 3
Partridge, Common, 2
Partridge, Red-legged, 2
Partridge, Rouloul, 2
Peewit (Lapwing), 18
Pelecanidæ (Family of Pelicans, Cormorants, Darters, &c.), 66
Pelican, White, 67
Penguin, Crested, 59
Penguin, Jackass, 62
Penguin, Patagonian (King Penguin), 59
Petrel, Blue, 63
Petrel, Fulmar, 62
Petrel, Grebe, 62
Petrel, Pintado (Cape Pigeon), 62
Petrel, Stormy (Mother Cary's Chicken), 62
Petrel, Wilson's, 63
Phœnicopteridæ (Family of Flamingoes), 38
Phalarope, Grey (Red Phalarope and Plain Phalarope), 26
Plataleidæ (Family of Spoonbills), 38
Plover, Golden, 18
Plover, Grey, 18
Plover, Long-legged (Black-winged Stilt-Plover), 23
Plover, Norfolk (thick-knee or thick-kneed Bustard), 18
Plover, Spur-winged, 19
Pratencole, Collared, 19
Procellaridæ (Family of Petrels and Shearwaters), 62
Ptarmigan, 2
Puffin, 58

Quail, 2
Quail, Kurrichane, 3
Quail, Rock, 3
Quail, Taijoor, 3
Quail, Virginian (Ortyx), 3

Rail, Virginian, 27
Rail, Water, 27
Rallidæ (Family of Rails and Coots), 26
Recurvirostridæ (Family of Stilt-Plovers, Avocets, &c.), 23
Rhea (Nandu), 10
Rhea, Darwin's, 10
Ruff and Reeve, 22

Sand-grouse, Pintailed (Pterocles), 2
Sand-grouse, Throat-banded, 2
Sandpiper, Red or Aberdeen (Knot), 23
Sandpiper, Little or Pigmy (Minute Dunlin and Little Stint), 23
Sandpiper, Marsh, 23
Scissors-bill (Sea-skimmer, Cut-water, &c.), 66
Scolopacidæ (Family of Curlews, Snipes, Sandpipers), 19
Screamer, Crested, 30
Screamer, Horned, 30
Shag or Green Cormorant (Crested Cormorant), 70

Shearwater, Manks, 62
Sheldrake, 46
Shortfoot, Glossy-headed, 71
Shoveller, 42
Smew, 54
Snake-bird (Darter), 70
Snipe, 22
Snipe, Great, or Solitary, 22
Snipe, Jack, 22
Snipe, Painted African, 22
Spheniscidæ (Family of Penguins), 59
Spoonbill, Common, 38
Stilt-Plover, Black-winged (Long-legged Plover), 23
Stilt-Plover, Mexican, 26
Stilt-Plover, Palmated, 26
Stint, Little (Little Sandpiper), 23
Stork, 34
Struthionidæ (Family of Ostrich, Rhea, &c.), 10
Swan, Bewick's, 42
Swan, Black, 42
Swan, Black-necked, of Chili, 42
Swan, Polish, 42
Swan, Tame, 39
Swan, Whistling, or Hooper, 42
Swift-foot, Black-billed, 19

Talegalla, Wattled (Brush-Turkey), 6
Tantalidæ (Family of Ibis, Tantalus, &c.), 35
Teal, Blue-winged, 46
Teal, Common, 46
Tern, Common, 63
Thick-knee (Stone Curlew, Norfolk Plover), 18
Tinamou, Tataupa, 6
Tropic-Bird, Common, 66
Trumpeter, Gold-breasted; or Agama, 30
Turkey, Brush (Talegalla), 6

Umber, Tufted, 34

Waterhen (Moorhen), 27
Whip-poor-will, 71
Whimbrel, 19
Wigeon, 46
Wigeon, American, 47
Willet, 23
Woodcock, 22

CLASS REPTILIA (Reptiles).

Acanthopis (genus of poisonous snakes), 122
Acontias, painted (Javelin Snake), 99
Adder (Viper), 114
Agama, Changeable, 91
Agama, Spiny, 91
Alligator, pike-nosed (Pike-nosed Caïman or Cayman), 79
Amphibia (Order of Amphibious reptiles), 123
Amphisbæna, Dusky, 98
Amphiuma, Three-toed (Amphibious reptile), 135
Anolis, Great crested, 90
Anolis, White-scarfed, 90
Asp (Egyptian Cobra, el Hajé), 118
Axolotl (Amphibious reptile), 135

Basilisk, Hooded, 90
Basilisk or Cockatrice, fabulous, 83
Blindworm (Slow-worm), 99
Boa, Aboma (Boa cenchria), 111
Boa, Anaconda (Boa scytale), 111
Boa, Bojobi (Boa Canina), 111
Boa, Emperor (Boa constrictor), 110
Boidæ (Family of Boas and Pythons), 110
Boiga (Tree-snake), 110
Bungarus, Banded (a poisonous snake), 123
Bushmaster (poisonous snake), 122

Cæcilia, Worm-like; Ringed; Two-banded, 126
Cæciliadæ (family of snake-like reptiles), 126
Caïman, Pike-nosed (Pike-nosed alligator), 79
Cerastes, Egyptian, 115
Cerastes, South African, 115
Ceratophris, Boié's (Frog), 127
Chalcidæ (a family of snake-like lizards), 95
Chamæleonidæ (Family of Chameleons), 83
Chameleons, Structure and Habits of, 83
Chameleon, Common, 86
Chameleon, Fork-nosed, 86
Chelodina, New Holland (Marsh Tortoise), 78
Chelonia, an Order of Reptilia including the Tortoises, 74
Chirotes, Channelled, 98
Chirotherium (fossil amphibious reptile), 134
Cobra, Egyptian (Asp), 118
Cobra de Capello (Naja), 118
Colubridæ (Family of Colubrine Snakes), 107
Crocodiles, 82
Crocodile, Common, 82
Crocodile, Gangetic (Gavial), 83
Crocodiles, fossil, 83
Crocodilidæ (Family of Crocodiles, Alligators, &c.), 79

Death-adder (Acanthopis), 122
Dipoglossus, Sagra's, 99
Dipsas (Tree-snake), 110
Dragon, Fringed, 90

El-Effah (a species of Viper), 115
Enaliosauria (Extinct marine lizards, Ichthyosaurus, and Plesiosaurus), 102, 103
Eryx, Bengal (Serpent), 114

Frog, Water; Bull; Painted; 126, 127

Gavial (Crocodile of the Ganges), 83
Geckos, Structure and Habits of, 86
Gecko, Banded, 87
Gecko, Egyptian, 87
Gecko, Milius's, 87
Gecko, Seychelles, 87
Gecko, Smooth-headed, 86
Geckotidæ (Family of lizards called Geckos), 86
Geosaurus, Sœmmering's (fossil lizard), 102
Glass-Snake, 95

Hamadryas (a large poisonous serpent), 114, 119
Heloderma, Rough-scaled (Varanidæ), 94
Herpeton, Tentacled (serpent), 114
Hydridæ (a family of marine snakes), 123

Ichthyosaurus (Extinct marine lizard), 102
Iguana, Common, 87
Iguana, Smooth-necked, 87
Iguanidæ (Family of Iguanas), 87
Iguanodon, extinct reptile, Fossil remains of, 87

Karroo-Bokadam (Snake), 114

Labyrinthodon (Chirotherium), 134
Lacertidæ (Family of True lizards), 94
Leptophis, Purple (Snake), 110
Lizard, Anguine, 95
Lizard, Cordyle (Common Zonurus), 99
Lizard, Frilled, 91
Lizard, Muricated (Agama), 91
Lizard, Sand, 94
Lizard, Viviparous, 94
Lycodon, Cape (Snake), 110

Mabouya or ocellated Scink, 99
Megalosaurus (enormous extinct lizard), 102
Menopome (Amphibious reptile), 131
Mosasaurus, Camper's (fossil gigantic lizard), 102

Natter-jack (Toad), 127
Naja, Indian (Cobra de Capello), 118
Naja, masked, 118
Necturus (Amphibious reptile), 135
Newt, Common Water; Smooth; Straight-lipped; Palmated; 130, 131.

Ophidia (an order of Reptiles, Serpents), 103
Ophiops (Lizard), 95
Oular-carron (Snake), 110

Palæophrynos (Fossil toad), 130
Plesiosaurus (extinct marine lizard), 103
Proteus (amphibious reptile), 135
Pterodactyles (Fossil winged lizards), 99
Python, Port Natal, 114
Python, Tiger (Python Tigris), 114
Pyxis, Arachnoid (Tortoise), 75

Ranidæ (Family of Frogs, Toads, &c.), 126
Rattle-snake, 122
Reptilia, Reptiles, a class of Vertebrate animals, 74

Safeguard, Great American (or Teguixin), 94
Salamander, Gigantic fossil, 134
Salamander, spotted, or Land Newt, 131
Salamandridæ (Family of Tritons, Newts, &c.), 130
Sauria (an order of Reptiles, Lizards), 79
Scheltopusic (Pseudopus Pallasii), 95
Scincidæ (Family of Lizards termed Scinks or Skinks), 98
Scink, Officinal, 98
Scink, Ocellated (Mabouya), 99
Sea-snake, Banded, 123
Sea-snake, Bicoloured, 123
Seps, Common, 99
Serpent-charming, 119
Serpents, General history of, 103
Sieboldtia (a large amphibious reptile), 134
Siren, Striated (amphibious reptile), 135
Slow-worm (Blindworm), 99
Snake, Javelin (Painted Acontias), 99
Snakes, poisonous, 114
Snake, Ringed or Common, 10
Snake-lizard, Four-toed, 95
Sphenops, Capistrated, 99
Stellio, Common, 90
Stellio, Spine-footed, 90

Tachydromus, Six-lined (Lizard), 95
Teguixin, Great American Safeguard, 94
Teidæ (Family of Lizards, called Teguixins), 94
Toad, Common, 127
Toad, Mitred; Bicoloured; Marbled; Surinam, 130
Tortoises, 74
Tortoise, Alligator, 78
Tortoise, American river, 78
Tortoise, Furrowed, 75
Tortoises of Galapagos Islands, 75
Tortoises, Marsh, 78
Tortoises, River, 78
Tree-snake, Golden, 110
Tree-frog, Green; Bicoloured, 127
Tropidophorus, Cochin China, 98
Turtle, Hawksbill, 79
Turtle, Green, 78
Turtle, Leathery, 79
Turtles, or Marine Tortoises, 78

Varan, Bell's, 94
Varan of the Nile, 91
Varan, White-throated, 91
Varanidæ (Family of large Lizards, termed Varans), 91
Viper, or Adder, 114
Vipere, Fer-de-lance, 122
Viper, Unadorned, 115

Zonurus, Common (Cordyle lizard), 99

CLASS PISCES (Fishes).

Abdominales (section of Malacopterygious Fishes), 150
Acanthopterygii (Order of Fishes), 139
Anchovy, 166
Apodes (an Order of Malacopterygious fishes), 171

Barbel, 150
Basse; Basse, Black, 139
Blenny, Ocellated (Butterfly-fish), 147
Bream, 151
Braize (Becker), 143
Brill, 171
Bullhead, River (Miller's Thumb), 142

Carp, 150
Chætodon, Bat; Surgical; Wandering; 143
Char, Northern; Welsh, 159
Cheilodactyle, Carmichael's, 143
Chondropterygii (Cartilaginous group of fishes), 175
Chub, 151
Clupeidæ (Family of Pilchards, Herrings, &c.), 162
Coal-fish, 167
Cod-fish, 167
Coracle, Portable boat used by Welsh Fishermen, 175
Coryphæna, Starred, 146
Cyprinidæ (Family of Carps, Gudgeons, Dace, &c.), 150

Dab (Saltie), 170
Dace, 151
Dog-fish, Small spotted, 175
Dorado, or Dolphin, 146
Dragonet, Gemmeous, 147

Eel, British Species of, 171
Eel, Sharp-nosed, 171
Eelfare (Eel), 174
Esocidæ (Pikes, Gar-fish, &c.), 154

Fishes, general structure and divisions of, 138
Flounder (Flook, Fleuke, or Fluke), 170
Fluke (Flounder), 170
Flying-fish, 154

Gadidæ (Family of Cod-fish, Coal-fish, &c.), 167
Gar-fish (Sea-pike), 154
Gilt-head (Golden Maid), 150
Gobiadæ (Family of Blennies, Gobies, &c.), 147
Goldfinny, 150
Grig (Eel, Anguilla), 171
Grilse (Young Salmon), 155
Gudgeon, 151
Gurnard, Streaked, Flying, 142
Gymnodontidæ (Family of Globe-fishes, Sun-fishes, Diodons, &c.), 175

Herring, 163
Herring, Garvie (Sprat), 166
Hippocampus, 174
Hound, Smooth (Dog-fish), 175

Labridæ (Family of Wrasses, or Rock fishes), 147
Lepidosiren, 138
Loche, Sea (Three-bearded Rockling), 167
Lophobranchii (Section of Fishes), 174
Loricati (Gurnards, &c.), 142

Mackerel (or Mackarel), 143
Mackerel, Horse (Scad), 146
Maid (Thornback), 175
Malacopterygii (Order of Fishes), 150
Manure, Fish used as, 166
Mugilidæ (Family of Grey Mullets), 147
Mullet, Grey, 147
Murænidæ (Family of Eels, Congers, &c.), 171
Muskanungee (Pike, American), 154

Parr, or Samlet, 159
Parrot-fishes (Scarus), 150
Perch, 139
Percidæ (Family of Perches), 139
Pike, 154
Pilchard, 162
Pipe-fish, Deep-nosed, 174
Piper, 142
Pisces (Class of Fishes), 138
Pleuronectidæ (Family of Plaice, Turbot, Soles, and Flat-fish generally), 167
Pogge, Japanese (armed Bullhead), 142
Polynemus, Artedis's, Four-rayed, 142
Porbeagle (Dog-fish), 175
Protopterus (Lepidosiren), 138
Pteraclis, Ocellated, 146

Raiidæ (Family of Rays and Skate), 175
Rockling, Five-bearded, 167
Rockling, Three-bearded, 167

Salmo, Genus, British species of, 162
Salmon, 154
Salmon-fishing, 158
Salmonidæ (Family of Salmon, Trout, Char, &c.), 154
Sciænidæ, (Family of Maigres), 143
Scombridæ (Family of Scombers, Mackerel, Tunnies, Sword-fish, &c.), 143
Shad, Twaite, and Allice, 166
Sharks, and Dog-fish, 175
Smelt (Sparling, and Spirling), 159
Smelt, Sand, or Atherine, 159
Sole, 171
Sole, Lemon, 171
Sole, Marbled, 171
Sole, Variegated, 171
Squalidæ (Family of Sharks, Dog-fish, &c.), 175
Squamipinnati (Family of Chætodons), 143
Sparidæ (Family of Sea-Breams), 143
Sprat, 166
Stickleback, 142
Sturgeon, Beluga (Accipenser Huso), 175
Sturgeon, Great, of Caspian Sea, 175
Sturgeon, Sevruga, 175
Sturionidæ (Family of Sturgeons), 175
Subbrachiales (Section of Malacopterygious Fishes), 167
Sun-fish, Short, 175
Sword-fish, 146
Syngnathidæ (Family of Pipe-fishes), 174

Thresher, or Fox-shark (Squalidæ), 175
Thornback, 175
Torsk, 167
Trout, 158
Trout, Great Grey, 159
Turbot, 170

Whiting, 167
Wrasse, Ballan, Green-streaked, Red, or three-spotted, Rainbow, Ceylonese Green, 147, 150

Sub-kingdom MOLLUSCA (HETEROGANGLIATA, Owen).

CLASS CEPHALOPODA (Cuttle-fishes).

Ammonites, 186
Argouaut (Argonauta Argo), 183

Belemnites, 186
Bellerophon, wide-mouthed, 183
Beloptera sepioidea, Belemnoidea, 187

Calamary, Common (Cuttle-fish), 179
Cephalopoda, Cuttle-fishes, 178
Cephalopods, Fossil, 186
Clymenia, 187
Cranchia, Rough (Cuttle-fish), 179
Cuttle-fishes (Cephalopoda, Class), 178
Cuttle-fish, Ventricose, 179
Cuttle-fish, Common (Poulp), 178
Cuttle-fish, Officinal (Sepia officinalis), 182
Cuttle-fish, Ink of, 179
Cyrtoceratites (Shelled Cephalopods, Fossil), 187

Gouiatites, 187

Heterogangliata (Mollusca), Sub-kingdom, 178

Lituites, 187

Mollusca (Heterogangliata), Sub-kingdom, 178

Nautilus, Pearly, 182
Nautilus, Umbilicated, 182

Octopus vulgaris (Common Cuttle-fish), 178
Onychoteuthis, Banks's Cuttle-fish), 179
Orthoceratites (Shelled Cephalopods, Fossil), 187

Phragmoceras, 187

Rhyncholites (Fossil beaks of Nautili), 183
Rossea, Arctic (Cuttle-fish), 179

Sepiola, Common (Cuttle-fish), 179
Sepiola, Short-armed (Cuttle-fish), 179
Spirula (Shelled Cephalopod), 186
Squid (Rock-squid, a Cuttle-fish), 178

Thunderstones (Belemnites), 187

CLASS PTEROPODA (Wing-footed Mollusks).

Cimbulia (Pteropoda), 190
Cleodora (Pteropoda), 190
Clio borealis (Pteropoda), 187
Cresis (Pteropoda), 191
Hyalæa (Pteropoda), 190
Pteropoda (Wing-footed Mollusks, Class), 187
Spiratella (Pteropoda), 190

CLASS GASTEROPODA (Gastropodous Mollusks).

Ampullaria, Cornu Arietis, dubia, globosa, 215
Anastoma (Helicidæ), 195
Ancylus, Freckled Radiated (Tectibranchiata), 206
Aplysia depilans (Tectibranchiata), 206
Atlanta Peronii (Heteropoda), 210
Auricula Midæ, 199
Auriculadæ (Family of Shells, Auricula Melampus, &c.), 199

Balea (Helicidæ), 195
Berthella porosa (Tectibranchiata), 206
Buccinidæ (Family of Whelks, Harp-shells), 234
Bulla fragilis, Velum, Ampulla (Tectibranchiata), 207
Bulladæ (Family of Tectibranchiata, Mollusks), 207
Bullæa, Aperta, Ferussacii (Tectibranchiata), 207
Bulinus,' Roseate, Blood-lipped, Three-banded (Helicidæ), 198
Bursatella (Tectibranchiata), 206

Cancellaria, Reticulated (Buccinidæ), 235
Cancellaria (Volutidæ), 227
Capulidæ (Family of Pectinibranchiate Gastropods), 222
Carinaria (Heteropoda), 210
Carocolla (Helicidæ), 195
Cassidaria, Spinous (Buccinidæ), 235
Cassis, Tuberose (Buccinidæ), 235
Cavolina (Nudibranchiata), 203
Cerithium, Marsh; Madagascar, 238
Chiton, Chilian, De Blainville's, Tufted, Peruvian, Spinose, Spiniferous, Coquimbo, Magnificent, 251
Chitonellus, lævis, larvæformis, 251
Chitonidæ (Family of Chitons), 251
Clausilia (Helicidæ), 198
Columbella (Volutidæ), 227
Columbella Mercatoria, 239
Concholepas, Peruvian, 238
Cone, Ordinary (Shell), 223
Conidæ (Family of Cone-shells), 222
Conoclix lineatus, 223
Coriocella nigra, 222
Cowry, Map, Mole, Vetch, Children's, Adanson's, Blotched, Money, Straitened, Freckled, 230
Cowries, Fossil, 231
Cryptosoma Leachii, 222 (Mollusks), 247
Cyclobranchiata (Order of Gastropodous
Cyclostoma (Helicidæ), 198
Cymba (Volutidæ), 223
Cypreidæ (Family of Cowries), 227
Cypræovula capensis, 231

Dentalium, 250
Diphyllidia Brugmausii (Inferobranchiata), 206
Dolabella (Tectibranchiata), 206
Dolium, Helmet (Buccinidæ), 235
Doris (Nudibranchiata), Habits of, 206
Doris, Horned, Flat, Jagged, Leach's (Nudibranchiata), 202
Dye, Tyrian (Imbricated Purpura), 235

Eburna, Smooth (Buccinidæ), 234
Emarginula, De Blainville's, Common, Emarginata, Depressed, 247
Eolidia (Nudibranchiata), 203
Erato scabriuscula (Tearshell), 231
Eulimia, Major, splendidula, 218

Fasciolaria, Tulip, 239
Firola (Heteropoda), 210
Fissurella, Cloudy, Roseate, Greek, 246
Fissurellidæ (Family of Shells, Fissurella, Emarginata, &c.), 246
Fusus Colus, 239

Gasteropoda (Division of, into Orders), 194
Gasteropoda (Slugs, Snails, and Univalve-shelled Mollusks, as Whelks, Cowries, &c.) Class, 191
Gasteroptera Meckeli (Tectibranchiata), 207
Glaucus (Nudibranchiata), 202

Haliotidæ (Family of Sea-Ears, Shells), 246
Harpa (Buccinum), 234
Harp, Ventricose, 234
Helicarion (Helicidæ), 198
Helicidæ (Family of Snails, Helix, Bulinus, &c.), 195
Helix pomatia, 195
Heteropoda (Order of Gasteropoda), 210
Hipponyx acutus, 222

Inferobranchiata (Order of Gastropodous Mollusks), 206

Janthina, 218, 219

Laniogerus (Nudibranchiata), 202
Leptoconchus striatus, 219
Limacella, 195
Limacidæ (Family of Slugs), 194
Limnæa, Common, Spreading, 199
Limneidæ (Family of Shells, Limnæa, Planorbis, &c.), 198
Limpet, Common, Gilded, Compressed, Scutellar, Spoon-shaped, Pectinated, Boat-shaped, 250
Litiopa, 218
Lobaria carnosa (Tectibranchiata), 207
Luponia algoensis (Cowries), 231

Magilus antiquus, 243
Marginella (Volutidæ), 227
Megaspira (Helicidæ), 198
Melampus coniformis (Auriculadæ), 199
Melania amarula, aurita, subulata, 218
Melanopsis, atra, costata, præmorsa, 218
Melibe rosea (Nudibranchiata), 206
Melo (Volutidæ), 223
Mitra, adusta, corrugata, episcopalis, 226
Mitra (Volutidæ), 227
Murex haustellum (Woodcock's Head), 242
Murex regius, 242
Murex tribulus (Thorny Woodcock), 242
Muricidæ (Family of Murices, Spindle Shells, &c.), 239
Muricidæ, Fossil, 242

Nassa (Buccinum), 234
Natica melanostoma (Turbinidæ), 215
Navicella elliptica (Turbinidæ), 214
Nerita, ascensionis, polita, pulligera, 214
Notarchus Cuvieri (Tectibranchiata), 206
Nudibranchiata (Order of Gastropodous Mollusks), 199

Oliva maura, sanguinolenta, textilina, 226
Oniscia, Cancellated (Buccinidæ), 235
Ovulum, Ovum, verrucosum, margarita, pyriforme, gibbosum, longirostratum, volva, 231

Paludina, parvula, vivipara, 215
Paramophorus austral, 247
Parmacella, 195
Partula (Helicidæ), 195
Patellidæ (Family of Limpets), 247
Pectinibranchiata (Order of Gastropodous Mollusks), 210
Periwinkle (Turbinidæ), 211
Phasianella (Turbinidæ), 214
Phyllidia pustulosa (Inferobranchiata), 206
Physa, Common (Limnæidæ), 199
Pileopsis ungarica, 222
Placobranchus ocellatus (Nudibranchiata), 206
Planaxis sucata (Buccinidæ), 234
Planorbis, Horny, 198
Planorbis, Keeled, 199
Plecochcilos (Helicidæ), 198
Pleurobranchæa Meckeli (Tectibranchiata), 206
Pleurotoma, Eared; Turreted, 239
Pteroceras Scorpion, 243
Pterosoma (Nudibranchiata), 202
Pulmonobranchiata (Order of Gasteropoda), 194
Pupa (Helicidæ), 195
Purpura, Imbricated; Persian, 235
Pyrula, Bat-like; Fig-like, 239

Ranella, Foliated (Muriadæ), 242
Ricinula, Spinous (Buccinidæ), 235

Scutibranchiata (Order of Gastropodous Mollusks), 246
Scyllæa pelagica (Nudibranchiata), 206
Sea-Ear (Haliotis) Tuberculated; Ribbed; Ruddy, 246
Sigaretus convexus, 222
Siliquaria, Muricated, 246
Siphonaria sipho (Tectibranchiata), 207
Slug, The Red—The Great Grey, 194
Slug, Shielded, 195
Snail, Large Garden (Helix aspersa), 195
Solarium variegatum (Trochidæ), 210
Sormetus Adansonii (Tectibranchiata), 207
Spindle, Chinese (Rostellaria), 243
Stomatia (Haliotidæ), 246
Streptaxis (Helicidæ), 195
Strombidæ (Family of Strombus, Pteroceras, &c.), 242
Strombus, Broad-winged, 243
Stylifer, astericola; Turtoni; Subulatus, 219
Subula, Spotted (Buccinidæ), 234

Tectibranchiata (Order of Gastropodous Mollusks), 206
Terebellum, convolutum; subulatum, 27
Terebra (Buccinidæ), 234
Tergipes (Nudibranchiata), 203
Testacella, 195
Tethys (Nudibranchiata), 203
Trichotropis, Bicarinated, 239
Triton (Muricidæ), 242
Tritonia Hombergii (Nudibranchiata), 206
Trivia, Carnea, Europæa; Pediculus; pustulata, 231
Trochidæ (Family of Pectinibranchiate Gastropods), 210
Trochus, Imperialis; Obeliscus, 210
Tubulibranchiata (Order of Gastropodous Mollusks), 243
Turbinella Rapa, 239
Turbinidæ (Family of Pectinibranchiate Gastropods), 211
Turbo, Cookii; Marmoratus; Torquatus, 211
Turritella, Rosea; Terebra(Turbinidæ), 214

Umbrella (Tectibranchiata), 206

Valvata piscinalis (Turbinidæ), 215
Velutina, 222
Vermetus, Dentilated; Lumbricoid, 248
Vertigo (Helicidæ), 195
Vitrina (Helicidæ), 198
Voluta, Pacifica, Undulata; Vespertilio, 226
Volutidæ (Family of Volutes, Olive Shells, &c.), 223
Volvaria (Volutidæ), 227

Wentletrap, Royal Staircase (Scalaria), 214
Whelk, Waved or Common, 234

CLASS CONCHIFERA (Acephalous Mollusks, with Bivalve Shells).

Alasmodonta undulata; complanata, 267
Amonia, Saddle; Squamous, 259
Amphidesma, 275-278
Anodon, Splendid, Fluviatile, 267
Auodonta fluviatilis, undulata, 267
Anatina subrostrata, 282
Arca tortuosa, antiquata; Diluvii, 270
Arca Noæ (Noah's Ark), 270
Arcadæ (Family of Ark Shells), 270
Arcadæ, fossil, 271
Aspergillum Javanicum, vaginiferum, 287
Avicula, 263

Capsa, Brazilian, 275
Cardiidæ (Family of Cockles, Mactræ, &c.), 275
Cardita, Calyculate, Imbricate, 270
Catillus, 262
Chama, Griphoid, 274
Chamidæ (Family of Chams), 271
Clam, Giant, Spotted, 274
Clam, Large Water, 259
Clavagella aperta, lata; Balnorum; Sicula, 287
Clotho, Faugas, 279
Cockle (Cardium edule), 275
Conchifera, Class, Characters of, &c. 251, 2 4
Coralliophaga, Cardite, 279
Crassatella, Common, 278
Creuatula, 262
Cucullæa, Eared, 270
Cumingia, Earless, 278
Cypricardia, 279
Cyprina, Common, 278
Cyrene, Darky, 278
Cytherea, Spined, White, 278

Diceras, Ram's Horn, 274
Dimyaria (Section of Conchifera), 263
Donax, 275
Dreissina, 266

Etheria, 263
Exogyra, Conical, 258

Fistulana clava, 287

Gastrochæna cuneiformis, 287
Gastrochænidæ (Family of Gastrochæna, Clavagella, &c.), 286
Gervillia, 262
Gratelupia, 275
Gryphæa, incurved, 258

Hemicardium, 275
Hinnites, Sinuous, 258
Hippopus (Tridacna), 274

Inoceramus, 262
Iridina, Exotic, Nile, 270
Isocardia, Heart, 275

Lamellibranchiata (Conchifera), 255
Lima, Squamous, 258
Lithodomus, 266
Lutraria, Solen-like, 282
Lutricola, Compressed, 282

Mactra, Brazilian, 278
Malleidæ (Family of Hammer-oysters), 262
Malleus vulgaris, 262
Margarita, 267
Meleagrinidæ (Family of Pearl-oysters), 263
Modiola, Sulcated, Cinnamon-coloured, 266
Monomyaria (Section of Conchifera), 255
Mussel, Edible, 263
Mya, Common, 282
Mya margaritifera (Unio elongatus), 267
Myadæ (Family of Shells, Mya Pandora, &c.), 282
Mytilidæ (Family of Mussels), 263
Mytilus, Choros; Magelanicus, 266

Naidæ (Family of Fresh-water Mussels), 267
Nucula, Bearded, Pearly, 271

Pachytes (Fossil), 262
Pandora, Beaked, 282
Pearl Oyster (Meleagrina margaritifera), 263
Pectinidæ (Family of Scallops and Oysters), 255
Pectunculus, Hairy, 271
Pedum, Spondyloid, 258
Perua, 262
Petricola, Pholadiformis, Dactylus, Ochroleuca, rupestris, subglobosa, 279
Pholadæ (Fam. of Pholas, Rock-borers), 283
Pholadomya, White, 282
Pholas, Dactylus, Clavatus, papyraceus, 283
Pinna, 266
Placunauomia, Cuming's, 259
Plagiostoma, 262
Platiris, 267
Plicatula, 262
Possidonia, 262
Pulvinites, 262

Sanguinolaria, Mediterranean, Roseate, 282
Saxicava, Rugose, Northern, 279
Scallop, Common (Flounder, Gibbous, Orbicular),
Solecurtus, Strigulate, 282
Solen, Vagina, Legumen, Ensis, 282
Solenidæ (Family of Solens or Razor-shells), 282
Soletellina, Radiated, 282
Spondylidæ (Family of Spiny Oysters, Clams, &c.), 259
Spondylus, Ducal, American, 259

Tellina, 275
Terediua, Masked, 286
Teredo navalis, Gigantea, 286
Tridacna, Giant (Giant Clam), Spotted, 274
Trigonia, Pearly, 271

Ungulina, Transverse, 279
Unio, Irroratus, Ochraceus, Cariosus, Radiatus, Alatus; Pictorum, Undulated, Flattened, Folded, 267
Unio, Plicate, Pustular, Purple, Spinous, 270

Venericardia, 270
Venerupis perforans (Boring Rock-Venus), 297
Venus, Cancellated, Pattershot; Common; 278
Vulsella, 262

Window-oyster, Chinese (Placuna), 259

Xylophaga (Pholas), 283

CLASS TUNICATA (Tunicate Mollusks).

Amaroucium proliferum, 290
Ascidia (Tunicata), 290

Boltenia reniformis (Tuuicata), 290
Botryllus, 290

Chelyosoma Macleayanum, 290
Cystingia Griffithsii, 290

Dendrodoa glandaria, 290

Fodia rubescens, 290

Ischadites Königii (fossil), 291

Polyclinum, 290
Pyrosoma, 290

Salpa firoloidea (Timoriensis), 290
Salpa fusiformis, 290
Salpa polymorpha, 290
Salpa zonaria, 290
Salpaceans (Salpa, &c.), 290
Sinoicum ficus, 290

Thalia (Salpaceans), 290
Timoricusis (Salpa firoloïdea) 290
Tunicata (Class of Tunicate Mollusks), 290
Tuuicata, aggregated, 290

CLASS BRACHIOPODA, OR PALLIOBRANCHIATA.

Brachiopoda, characters of Class, 291
Crania personata, 291
Lingula Audebardi; Anatina, 291
Magas Pumilus, 291
Orbicula Lamellosa, 291
Producta Martini, 291
Spirifer trigonalis, 291
Strigonocephalus Burtini, 291
Strophomena rugosa, 291
Thecidium radiatum, 291
Terebratula, globosa; dorsata, deformis, alata; rubra; Caput Serpentis; Lyra, canalifera, 291
Terebratula Chilensis; truncata, Psittacea, 291

CLASS CIRRHOPODA, OR CIRRIPEDA (Bernicles, (Acorn-shells, &c.).

Acasta Montagui, 295
Acorn-shells (Balani), 295
Alepas, shell-less bernicles, 294
Alepas parasita, 294
Balanus psittacus, 295
Balanus pusillus, 294
Balanus, tintinnabulum, 295
Bernicles or Barnacles, 294
Bernicle, common or duck, 295
Catophragmus imbricatus, 295
Cetopirus (Coronula), 295
Chelonobia (Coronula), 295
Chthalamus stellatus, 295
Cineras vittata (Gymnolepas), 295
Cirrhopoda, Characters of Class, 291
Cirrhopoda, fossil, 298
Cirrhopods, Pedunculated and Sessile, 291
Clitia verruca, 295
Conia porosa, 295
Coronula balænaris, 295
Coronula diadema, 295
Creusa gregaria, 295
Diadema (Coronula), 295
Gymnolepas (Otion Cuvieri), 294
Lepas anatifera (Pentalasmis), 294
Litholepas (Lithotrya), 295
Lithotrya dorsalis, 295
Octomeris angulosa, 298
Otion Cuvieri (Gymnolepas) 294
Pentalasmis anatifera (Lepas anatifera), 294
Policipes mitella, 295
Polylepas (Scalpellum), 295
Pyrgoma crenatum, 295
Scalpellum vulgare, 295
Tetralasmis hirsutus, 295
Tubinicella balænarum, 295

Sub-kingdom ARTICULATA, Cuv. (HOMOGANGLIATA, Owen).

CLASS CRUSTACEA (Crabs, Lobsters, &c.).

Acanthonyx, 310
Actheres, 327
Æga, 327
Æglea, 315
Albunea, 314
Alpheus, 318
Alima, 322
Amphipoda (Order of Crustacea), 323
Anomoura (Section of Crustacea), 314
Anthura, 323
Apus productus, 327
Armadillo, 326
Asellus, 326
Astacus (Lobster, River Cray-fish, &c.), 318
Atya, 318
Atylus, 323
Axia, 319
Birgus Latro (Pagurus Latro), 315
Bopyrus Crangorum, 323
Boscia, 303
Brachipus stagnalis (Brine Shrimp), 302
Brachyura (Short-tailed Decapods), 302
Branchiopoda (Order of Entomostraca), 326
Calappa, 311
Callianassa, 319
Callianidea, 319
Calligus, 327
Camposcia, 307
Cancer (Crabs), 302
Cancer pagurus (Large Edible Crab), 302
Canolira, 323
Cardisona, 306
Cenobita, 314
Cerapus, 323
Chorinus, 310
Cilicæa, 323
Condracanthus, 327
Corystes, 303
Corystians, 314
Crabs, 302
Crab, Common Edible, 302
Crabs, Latreille's arrangement of, 314
Crangon (Shrimp), 318
Criocarcinus, 310
Crustacea (Class), Structure and Divisions, 298
Cryptopodians, 311
Cryptopodia, 311
Cyamus Cete, 323
Cyclops, 327
Cymodocea, 323
Cymothoa, 323
Cypris, 327
Daphnia, 327
Decapoda (Order of Crustacea), 302
Doclea, 307
Dorippe, 303
Dromia, 303
Dynomene, 303
Egeon, 318
Egeria, 310
Entomostraca (Section of Crustacea), 298, 326
Epialtus, 310
Epizoa (See Lerneiform Crustacea), 327
Eriphia, 303
Erycthus, 322
Eryon, 319
Etisus, 303
Eumedonus, 310
Euryonome, 311
Eurypodius, 307
Galathea, 315
Gammarus (Fresh-water Shrimp), 323
Gebia, 319
Gecarcinians (Gecarcinus), 306
Gecarcinus (Black or Violet Land Crabs), 306
Gelasimus, 303
Grapsus, 307
Halimus, 310
Hepatus, 311
Herbstia, 310
Hermit or Soldier Crab, 314
Hippa, 314
Homola, 314
Hyas, 310
Hymenosoma, 307
Ibacus, 319
Idotea, 326
Inachus, 307
Ione, 323
Isopoda (Order of Crustacea), 323
Læmodipoda (Order of Crustacea), 323
Lambrus, 311
Land-crabs, 303
Leptomera pedata, 323
Leptopodia, 307
Lernæa, 327
Lerneiform Crustacea, 327
Lerneonema, 327
Leucippa, 310
Leucosians (Family of Crabs), 311
Libinia, 307
Ligia, 326
Limnoria, 323
Limulus, 327
Lissa, 310
Lithodes, 314
Lomis, 314
Lucifer typus, 322
Lupea, 302
Macropodians, 307
Macrura (Section of Crustacea), 318
Maia, 310
Maiidæ, 307
Malacostraca (Section of Crustacea), 298
Megalopa, 318
Melia, 303
Melita, 323
Micippa, 310
Mithrax, 310
Monoculus (Apus), 327
Mycteris, 307
Mysis (Opossum Shrimps), 322
Næsa, 323
Naxia, 310
Nelocira, 323
Ocypoda, 303
Œthra, 311
Oniscus (Wood-louse), 326
Oxyrhynchi, 307
Oxystoma, 311
Pactolus, 314
Pæcilopoda (Order of Entomostraca), 326
Pagurus (Hermit Crab), 314
Palæmon (Prawn and Medway Shrimp), 318
Palinurus (Langoustes or Sea Cray-fish), 319
Parthenope, 311
Penella, 327
Pericera, 310
Persephona, 311
Phyllophora, 327
Phyllosoma, 322
Pinnotheres, 307
Piremela, 303
Pisa, 310
Plagusia, 307
Platyonychus, 302
Podopthalmus, 302
Porcellana, 315
Portumnus, 302
Portunus, 302
Prawn (Palemon serratus), 318
Pychnogonum, 327
Ranina, 314
Remipes, 314
Ruppellia, 303
Sand-crab (Ocypoda arenaria), 303
Scyllarus, 318
Serolis Fabricii, 323
Shrimps, 318
Sphæroma, 323
Squilla, 323
Stenocinops, 310
Stenorhynchus, 307
Stenosoma, 326
Stomapoda (Order of Crustacea), 322
Suctorial Crustaceans, 327
Swimming Crabs, 302
Talitrus (Sand Hopper), 323
Thalamita, 302
Thalassina, 319
Thelphusa, 303
Thenus, 319
Tracheliastes, 327
Trilobites (Fossil), 326
Uça, 306
Violet Crabs, or Toulouroux, 303
Xantho, 302
Xiphosura (Sub-class of Crustacea), 327
Zoea clavata, 327
Zozimus, 303

CLASS ARACHNIDÆ (Spiders and Scorpions).

Acaridæ (Family of Mites, Ticks, &c.), 331
Arachnidæ (Class of Spiders and Scorpions), 330
Araneidæ (Family of Spiders), 330
Harvest-bug (Leptus Autumnalis), 331
Mites, 331
Phalangidæ (Family of Shepherd Spiders), 334
Scorpionidæ (Family of Scorpions), 331
Scorpions, European; American; African; 331 [334
Shepherd Spider, Common (Phalangium), 334
Spiders, Geometric; Gossamer; Hunting; Aquatic; Nest-builders; House; Eggs of, 331
Ticks (Ixodes), 331
Water-mites (Hydrachna), 334

CLASS INSECTA (Insects).

Æstrus Bovis; Tarandi; equi ovis, 355
Ametabola (Insecta), 358
Ants, History of, 379
Ants, Conflicts of, 382
Ants, Emigrations of, 382
Ants, European, 379
Ants in a state of slavery, 382
Ants of South America and Australia, 379
Ant-lion, larva, habits of, 363
Aphides, imprisoned by ants, 382
Aphis, puncturing sucker of, 335
Aphis, experiments on reproduction of, 387
Apparatus, Entomological, 398
Bedeguar gall of wild rose, 354
Bee-bread, 374
Bee, sting of, 351
Bee, structure of mouth, 335
Beetle, Sacred, of Egyptians, 383
Beetles, Carnivorous, jaws of, 334
Beetles, Vegetable feeders, jaws of, 334
Blatta, Foot-cushions of, 338
Blaps mortisaga (Church-yard Beetle), 366
Blow-fly, Chequered; green, 358
Bluebottle, Common, 358
Bocidium galeritum; tintinnabuliferum, 387
Brentus Temminckii, 383
Brown Ant (Formica fusca), 379
Butterflies, British, 387
Butterfly, Proboscis of, 335
Caddis Worms, 367
Carabidæ (family of Beetles), 383
Carder-bee (B. muscorum), history of, 375
Carpenter-bees, galleries of, 347
Carpenter-wasps, 347
Caterpillars or larvæ, characters of, 358
Cecidomya destructor (Hessian Wheat-fly), 350
Chaffer-beetle, larva, 366
Chameleon-Fly, aquatic larva of, 370
Cheese-fly, ovipositor and caterpillar of, 350
Chrysalis, 359, 362
Churchyard Beetle (Blaps mortisaga), 366
Cicada hæmatodes, 351
Cicada, Ovipositor of, 351
Cicindelidæ (Family of Beetles), 383
Cimex lectularius, 386
Cimicidæ (Family of Insects), 386
Classification of Insects, 386
Clothes-moths (Tineæ), Caterpillars of, 367
Coccidæ (Gallinsecta), 347
Coccus, 350
Cochineal Insect, 350
Cocoons of Caterpillars, 359
Coleoptera (Order, Characters of), 386
Combs of Bees, Construction of, 374
Coreidæ (Family of Insects), 386
Corn-Weevil (Calandra granaria), 366
Crane-Flies (Tipulæ), Ovipositor of, 350
Crepuscularia, Section of Lepidoptera, 387
Ctenophora flaveolata, ornata, 398
Currant-galls of Cynips, 354
Cynips Quercus-folii, Rosæ; Quercus-gemmæ; Genistæ; Quercus, 354
Destructiveness of Larvæ, 366
Development of perfect insect, 363
Diopsis Sykesii, 398
Diptera (Order, Characters of), 398
Diurna, Section of Lepidoptera, 387
Dragon-Fly, Larva and Pupa of, 370
Egg-raft of Gnat, 370
Eggs of Insects, their power of resisting cold and heat, 346
Ephemera, May-fly, 367
Epipone (genus of Wasps), 378
Fallow Ant (Formica rufa), 379
Field-Cricket, Acheta, cry of, 339
Fire-fly of West Indies (Elater noctilucus), 383
Fly, sucking proboscis of, 338
Forest-fly (Hippobosca equina), 398
Froghopper (Cercopis spumaria), 366
Fulgora laternaria, 383
Fulgoridæ (Family of Insects), 386
Fur-moths (Tineæ), Caterpillars of, 367
Gad-fly (Æstrus Bovis), 355
Gall-flies (Cynips), 354
Galls of Aphis, 354
Galls of commerce, 354
Galls of Weevils (Curculio), 354
Gallinsecta (Coccidæ), 347
Geometridæ (Family of Moths), 394
Glow-worm (Lampyris noctiluca), 383
Gnats, Piercing Suckers of, 338
Gnat, Egg-raft of, 346
Gnat-tribe, Aquatic Larvæ of, 370
Grasshoppers, Ovipositor of, 350
Growth of Caterpillars, 358
Harpalidæ (Family of Beetles), 383
Hawk-moths, British, 390
Hawthorn Coccus, 350
Hemiptera (Order, characters of), 386
Hippobosca, hirundinis; equina, 398
Hive Bee (Apis mellifica), History of, 371
Homoptera (Order, characters of), 386, 387
Honey, 374
Hoppers, Maggots of Cheese-fly, Piophila casei), 350
Hornet (Vespa Crabro), 378
Humble-bee (Bombus terrestris), History of, 375
Hydrometridæ (Family of Insects), 386
Hymenoptera (Order, characters of), 386
Ichneumon-flies, Ovipositor of, 351
Imago, 371
Insecta (Class of Insects), general observations, 334
Insects, Abdomen of, 338
Insects, Antennæ of, 343
Insects, Circulation of blood of, 339
Insects, Classification of, 386
Insects, Digestive apparatus of, 342
Insects, Dipterous, Sucking disc of limbs of, 338
Insects, Haustellate, mouth of, 335
Insects, Hearing of, Taste of, Touch of, Smell of, 343
Insects, Instinct of, in depositing their eggs, 346
Insects, Eggs of, 346
Insects, Limbs of, 338
Insects, Luminous, 383
Insects, Mandibulate, Structure of, Head, Mouth, Trophi, 334
Insects, Muscles of flight of, 339
Insects, Muscular system of, 342
Insects, Nervous system of, 342
Insects, Locomotion of, 338
Insects, Organs of Vision of, 342
Insects, Respiration of, 339
Insects, Structure of, 346
Insects, Thorax of, 338
Insects, Vocal Powers of, 339
Insects, Wings of, 338
Jet Ant (Formica fuliginosa), 379
Lac Insect, 347
Lamia Amputator, 383
Lampyris noctiluca, splendidula, 383
Lantern-fly (Fulgora laternaria), 383
Larvæ of Insects, Structure and Habits of, 358
Larvæ, Aquatic, Habits of, 367
Larvæ of Coccinella, Chrysopa, Cassida, &c., 366
Leaf-cutting Bees, 347
Leaf-mining Caterpillars, 367
Leaf-rolling Caterpillars, 362
Leaf-roller, Eggs of, 346
Legionary Ants, 382
Lepidoptera (Order, Characters of), 387
Limbs of Caterpillars, 358
Locust, 386
May-fly (Ephemera), 367
Maggots, Rat-tailed, 370
Mantis, 386
Markwick Fly (Chlorops pumilionis), 350
Mason-Bees, Cells of, 347
Mason-Wasps, Cells of, 346
Meal-worm (Larva of Tenebrio Molitor), 366
Metabola (Insecta), 358
Mining-Bees, Pits of, 347
Mole Cricket, Nest of, 350
Moth, Proboscis of, 335
Moth, Lackey; Gipsy; Vapourer, eggs of, 346
Moths, British, 391
Moulting of Caterpillars, 358
Nematus Capreæ, 351
Nematus Ribesii, 351
Neuroptera (Order, characters of), 386
Nocturna, Section of Lepidoptera, 387
Nut-weevil (Balaninus nucum), 366, 383
Nycteribia (Batlice), 398
Oak-apples, 354
Orthoptera (Order, characters of), 386
Ovipositors of Insects, 350
Phasma (Leaf insects), 386
Phryganea, 367
Processionary Caterpillars, 362
Propolis, 374
Pupa, 359, 362
Pupa-case, 368
Pupæ, ametabolous and metabolous, 371
Pygolampsis italica (Fire-fly), 383
Reduviidæ (Family of Insects), 386
Sawflies (Tenthredo), Ovipositor of, 351
Scarabæidæ (Family of Beetles), 383
Scarabæus (Ateuchus), Ægyptiacus; Sacer, 383
Selandria alni, 351
Sphingidæ, Hawk Moths, 390
Silk apparatus of caterpillars, 358
Silk-worm, 359
Stag-beetle, Lucanus Cervus, 383
Sting of Bees and Wasps, 351
Structures of larvæ, 367
Suctorial Insects, suckers of, 335
Swarming of ants, 379

Tenthredo (Saw-fly), 351
Tents of Caterpillars, 359
Termes, atrox; arborum, mordax, 383
Termes bellicosus, lucifugus, 382
Termites, Habitation of, 382
Termites, History of, 382
Termites, Ravages of, 383
Thistle-fly, Tephrites Cardui, 354
Transformations of Caterpillars, 359
Tree-hoppers, Cicadæ, voice of, 339
Turf ant (Formica cæspitum), 379
Vespa Britannica, Holsatica, 378
Vespiary, Structure of, 378
Wasp, Common (Vespa vulgaris), History of, 378
Wasp, Chiguana (Myraptera scutellaris), 378
Wasps, South American, Honey of, 379
Wasps' nests, Pendent, from Cayenne, 378
Water Boatman (Notonecta), 385
Water Scorpion (Nepa), 386
Wax, 374
Wheat-flies, eggs of, 350
Wire-worm (Larva of Elater), 366
Yellow Ant (Formica flava), 379
Zimb of Bruce, 355

CLASS MYRIAPODA (Centipedes, Millepedes).

Centipedes, 399
Chilognatha, section of Myriapoda, 398
Chilopoda, section of Myriapoda, 399
Craspedosoma, 399
Geophilus, electricus; longicornis, 399
Glomeris marginata, 399
Lithobius forficatus, 399
Millepede (Julus), 398
Myriapoda, Class; Characters of, 398
Pill Millepede, 399
Polydesmus, 398
Polyxenus, 399
Scolopendra, 399
Scolopendra largura (Polyxenus), 399
Scutigera coleoptrata, 399

CLASS ANNELIDA (Red-blooded Worms).

Abranchiata (Order of Annelida), 399
Annelida, Class; Characters of, 399
Detrupa subulata, 302
Dorsibranchiata (Order of Annelida), 399
Earthworm, 402
Geobdella Trochetii, 402
Gordius aquaticus, 399
Leech, 402
Leeches, Terrestrial, of Chili and Ceylon, 402
Lugworm, Arenicola piscatorum, 399
Nais, 399
Nereis phosphorescens, 399
Sea Mouse, Aphrodita aculeata, 399
Serpula contortuplicata, 399
Serpula vermicularis, 399
Terebellæ, 402
Tubicolæ (Order of Annelida), 399
Vermilia triquetra, 399

Sub-kingdom NEMATONEURA.

CLASS ECHINODERMATA.

Actiocrinites triacontadactylus, 402
Asterias, Structure and habits of, 403
Asterias rubens, tessellata, 402
Apiocrinites rotundus, 402
Bonellia viridis, 406
Comatula Adonæ, 402
Echinidæ (Family of Echini), 403
Echinidæ, fossil, 406
Echinodermata (Class, Characters of), 402
Echinus, Structure and Habits of, 403, 406
Encrinites, 402
Encrinus Liliiformis, 402
Entrochite Marble, 402
Euryale costata, palmifera, 402
Euryale gorgonocephalus, 402
Euryale scutata, 402
Fistularidæ (Family of Echinodermata), 406
Holothuria, Phantapus; papillosa; vittata; cucumis; tubulosa; ananas, 406
Holothuridæ, Family of Echinodermata, 406
Ophiura texturata, annulosa, granulata, 402
Ophiuræ, 403
Pentacrinus Briareus, 402
Pentacrinus Caput Medusæ, 402
Pentacrinus Europæus, 402
Scutellæ, 406
Siponculus edulis, 406
Spatangus, 403, 406
Stelleridæ (Family of Sea-stars), 402
Thalassema echiurus, 406
Tripang, 406

CLASS CŒLELMINTHA.

Cœlelmintha, Class, Characters of, 406
Filaria Medinensis, Oculi, 406
Guinea-Worm, 406
Linguatula, 406
Strongylus equinus, 406

CLASS ROTIFERA (Wheel-like Animalculæ).

Brachionus urceolaris, 407
Loricata, Section of Rotifera, 406
Notommata centrura, 407
Nuda, Section of Rotifera, 406
Rotifera, Class, Characters of, 405

CLASS BRYOZOA (Moss-Corals).

Acamarchis neritina, 407
Andonea foliifera, 407
Bryozoa, Class, Characters of, 407
Bowerbankia densa (Valkeria), 407
Caberea dichotoma, 407
Canda arachnoïdea, 407
Cellaria cervides; Salicornia loricata, 407
Cellepora pumicosa, 407
Ciliobranchiata (Bryozoa), 407
Discopora verrucosa, 407
Electra verticellata, 407
Eschara foliacea, 407
Elzerina Blainvillii, 407
Flustra carbasea, dentata, foliacea, avicularis, 407
Foraminifera, 407
Menipæa hyalina, 407
Pherusa tabulosa, 407
Retepora cellulosa, 407
Unicellaria chelata, 407
Valkeria imbricata, 407

Sub-kingdom ACRITA.

CLASS PORIFERA.

Acrita, Characters of, 407
Porifera, Sponges, Structure of, 410
Spongia, oculata, papillaris, cinerea, panicea, compressa, 410
Sponges, Fossil, 410

CLASS PHYTOZOA, or POLYPIFERA (Zoophytes and Corals).

Actinia Senilis, Coriacea; Equina; Plumosa; Jordaïca; Helianthes, 418
Actiniæ, Habits and Structure of, 418
Aglaophenia (Plumularia), 414
Alcyonidæ, Cartilaginous Phytozoa, 410
Alveopora retepora, 411
Antipathes, 414
Astræa, Ananas; rotulosa; favosa, 411
Brain Corals (Meandrina), 411
Campanularia volubilis, 414
Capnea sanguinea, 418
Caryophyllia cyathus, 411
Catenopora escaroïdes, 411
Cladocora cespitosa, 411
Columnaria, 411
Coral Islands, formation of, 411
Corallum rubrum (Red Coral), 414
Corticifera glareola (Zoanthidæ), 418
Dentipora virginea, 411
Dynamena operculata, 414
Edwardsia (Actinia), 418
Favosites Gothlandica, 411
Fungia, 411
Gemmipora, mesenterina, 411
Gorgonia, 414
Heleopora cærulea, 411
Heteropora cryptopora, 411
Hornera frondiculata, 411
Hydra, structure of, 410
Ilyanthus Scoticus, 418
Isis Hippuris (Horsetail coral), 414
Lithophytes, Stony Phytozoa, 411
Lucernaria auricula, 418
Madrastræa, 411
Madrephylliæa, 411
Madrepora abranoides, 411
Mammellifera auriculata (Zoanthidæ), 418
Meandrina, Dædalæa, 411
Milleporidæ, 411
Naisa reptans (Plumatella cristata), 414
Oculina axillaris, 411
Palmipora alcicornis, 411
Pavonia, 411
Pennatula, 414
Pennatulidæ (Seapens), 414
Phytozoa, Cortical, Tubular, 410
Phytozoa, Cartilaginous, Fleshy, 410
Phytozoa, Characters of, 410
Plexaura, 414
Plumatella cristata, 414
Plumularia Pluma, 414
Polypes, Simple, Compound, 411
Polypiaria dubia, group of Zoophytes, 414
Polypifera, corticiferous, 414
Polypifera, Compound, Tubular, 414
Porites clavaria, 411
Primnoa, 414
Red coral (Corallium rubrum), 414
Sea Anemonies (Actiniæ), 414
Sertularia, 414
Sertularinæ (Family of Zoophytes), 414
Stromatopora subconcentrica, 411
Stylina, 411
Syringopora geniculata, 411
Terebellaria ramosissima, 411
Thuiaria, 414
Tibiana fasciculata, 414
Tubipora musica, 410
Tubularidæ (Family of Zoophytes), 414
Umbellaria (Scapen), 414
Virgularia, 414
Zoantharia, Fleshy Polypes, 414
Zoanthidæ (Zoanthus, &c.), 418
Zoanthus Solanderi, 418
Zoophytes, Horny tubular, Economy of, 414
Zoophytes, Phosphorescent, 414

CLASS POLYGASTRICA (Polygastric Animalcules).

Bursaria truncatella, 419
Leucophrys patula, 419
Monads (Monas atomos), 419
Monas, 419
Polygastric Animalcules, Characters of, 418
Polygastrica, fossil, 418

CLASS ACALEPHÆ (Sea-nettles, Jelly-fish, &c.).

Acalephæ, Class, Characters of, 419
Æquorea cyanea, 419
Amphiroa alata, 423
Apolemia Urania, 422
Beroe ovata, 422
Callianira triploptera, 422
Calpe pentagona, 423
Cestum Veneris, 422
Charybdæa periphylla, 419
Ciliograda (Order of Acalephæ), 422
Cirrhigrada (Order of Acalephæ), 422
Euboides vitreus, 423
Cucubalus cordiformis, 423
Cucullus doreyanus, 423
Cyanea aurita, 419
Cydippe pileus, 422
Dianæa, 419
Diphyes Bory (D. Campanulifera), 423
Diphyida (Order of Acalephæ), 422
Doliolum Mediterraneum, 423
Enneagone hyalina, 423
Eudora undulosa, 419
Galeolaria Australis, 423
Lymnoria triedra, 419
Navicula sagittata, 423
Noctiluca miliaris, 423
Pelagia Labiche, 419
Physalia pelagica, 422
Physograda (Order of Acalephæ), 422
Physsophora muzonema, 422
Polybrachionia Linnæana, 422
Porpita gigantea; Glandifera, 422
Portuguese Man-of-war (Physalia pelagica), 422
Praia dubia, 423
Protomedea lutea, 422
Pulmonigrada (Order of Acalephæ), 419
Pyramis tetragona, 423
Rataria mitrata, 422
Rhizophysa filiformis, 422
Rhizostoma Cuvieri, 419
Rhodophysa helianthus, 422
Rosacea Ceutensis, 423
Sulculeolaria quadrivalvis, 423
Tetragona hispidum, 423
Thaumantias cymbaloidea, 419
Tima flavilabris, 419
Velella lata, 422

CLASS STERELMINTHA (Parenchymatous Worms).

Acanthocephala (Order of Sterelmintha) 423
Cestoidea (Order of Sterelmintha), 423
Cisticercus longicollis, 423
Cœnurus cerebralis, 423
Diplozoon pardoxum, 423
Distoma hepaticum, 423
Echinorhynchus gigas, 423
Hydatids (Cisticercus), 423
Ligula Cingulum, 423
Nemertes, 423
Planariæ, 423
Polystoma, 423
Sterelmintha (Class, Characters of), 423
Tænia solium; lata; lamelligera, 423
Tænoidea (Order of Sterelmintha), 423
Tapeworm (Tænia), 423
Trematoda (Order of Sterelmintha), 423
Concluding observations, 425
Additional remarks on Hybrids between the lion and tigress, ursine opossum, Chœropus, Sprat, 425
Arrangement of the Animal Kingdom, 425

CORRIGENDA.

Vol. II. page 290, middle col., 10 lines from the last, *dele* "Holothuria."
291, left-hand col., 29th line from the top, for "cariceous," *read* "coriaceous."
294, left-hand col., 9th line from the top, for "Pentalismis," *read* "Pentalasmis."

London: Printed by W. Clowes and Sons Stamford-street